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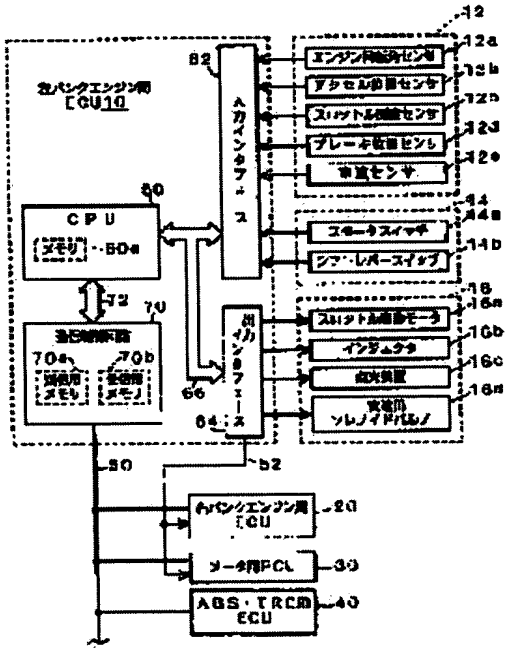
(54) ELECTRONIC CONTROLLER

(57)Abstract:

PROBLEM TO BE SOLVED: To easily specify the cause of a fault in detail if some abnormality occurs as to the electronic controller to which plural control units are connected through a communication line.

SOLUTION: In a vehicle control system which connects plural ECUs (electronic control unit) 10-40 controlling respective parts of a vehicle by the communication line 50 and sends and receives part of control data by using communication control circuits 70 in the respective ECUs, each ECU sends an abnormal state signal to other ECUs once detecting abnormality of detection data found on the basis of detection signals from a sensor group 12 or switch group 14 and arithmetic data, etc., obtained by calculating controlled variables of an actuator group 16. Each ECU when detecting abnormality of itself or receiving the abnormal state signal stores a memory 60a with all control data before and after it. Consequently, if this control system becomes abnormal, each ECU stores the control data at the same time and the vehicle state is grasped in detail from the control data to accurately specify the cause of the fault.



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CLAIMS

[Claim(s)]
[Claim 1] The electronic control which shares this control data with other control units when two or more control units which are characterized by providing the following, and which have means of communications are connected through a communication wire and a part of control data required for control of a controlled system is transmitted [each control unit] and received among other control units through the aforementioned means of communications and a communication wire. A malfunction detection means to detect the abnormalities of control data to each aforementioned control unit. When this malfunction detection means detected the abnormalities of control data and an abnormal-condition transmitting means to make the abnormal-condition signal showing that transmit to other control units from the aforementioned means of communications, and the aforementioned malfunction detection means detect the abnormalities of control data, And it is a data-storage means at the time of the abnormalities which store data in the predetermined storage which can be held continuously for the control data currently used for control of a controlled system when the aforementioned means of communications receives the abnormal-condition signal transmitted from other control units.
[Claim 2] A data-storage means is an electronic control according to claim 1 characterized by storing the control data of before malfunction detection and [this] the back in the aforementioned storage if the aforementioned malfunction detection means detects the abnormalities of control data, and storing the control data of before reception, and [of this abnormal-condition signal] the back in the aforementioned storage if the abnormal-condition signal with which the aforementioned means of communications has been transmitted from other control units is received at the time of the aforementioned abnormalities.
[Claim 3] Two or more aforementioned control units are electronic controls according to claim 1 or 2 characterized by distributing, respectively and controlling each part, such as an engine carried in vehicles, a change gear, and a brake gear.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the electronic control constituted so that this control data might be shared between each control unit by transmitting and receiving a part of control data required for control of a controlled system through a communication wire among two or more control units.
[0002]
[Description of the Prior Art] Conventionally, when abnormalities arise to the detection data computed based on the detecting signal from a sensor which detects the operational status of vehicles, the operation data which calculated controlled variables, such as fuel oil consumption and ignition timing, according to the detection data, what memorized these all control data to the predetermined storage to which stored data does not disappear by power supply interception etc. is known for the engine control system for vehicles.
[0003] This is because the vehicles state at the time of a heterology is grasped from the control data which carried out [above-mentioned] storage and a cause of fault can be specified easily, when it fits memorizing the engine control state at the time of for example, an emission associated part breaking down an engine control system (frieze frame) to the California onboard DAIAGU (OBD) regulation which specified and abnormalities occur in an engine control system.
[0004]
[Problem(s) to be Solved by the Invention] However, by the conventional method which memorizes the control data at the time of malfunction detection by the engine-control-system independent, since the control data to memorize was restricted to the data of an engine control system, from the stored data, it is difficult to grasp the whole vehicles state at the time of malfunction detection, and a cause of fault was not able to be specified in detail and with high precision. For example, although it is necessary to grasp correctly the rolling-stock-run state at the time of malfunction detection in order to specify the cause of fault when abnormalities occur in control data only under the run conditions of the specification of vehicles called the time of vehicles braking at the time of vehicles acceleration, even if it memorizes the control data at the time of malfunction detection by the engine-control-system independent, a cause of fault cannot be specified from the stored data.
[0005] moreover, with the control system for vehicles, especially in recent years For example, each [these] control unit is connected by the communication wire from the control system of the so-called standalone version with which the control unit of exclusive use performs respectively independently control to each controlled systems, such as engine control, transmission control, and brake control. Although each control unit is shifting to the so-called integration type control system which shares control data and controls vehicles synthetically by transmitting and receiving control data between each control unit In such a unified type control system, like before, even if an engine control system etc. memorizes the control data at the time of malfunction detection by each control unit independent Grasping the vehicles state at the time of malfunction detection from the stored data, specifying a cause

of fault has the problem of becoming still more difficult.
[0006] On the other hand, if a certain computer detects the abnormalities of other computers from the result of data communication conventionally in the communication system which performs data communication among two or more computers as indicated by JP,3-184154,A, the communication system which enabled it to perform data communication between each computer efficiently is known by forbidding the data communication to the computer which reported that to the remaining computers and abnormalities generated after that. and when applying such technology to the above-mentioned integration type control system and either of other control units detects the abnormalities of the specific control unit which constitutes this control system, what is made to report and memorize that is made to all the control units that are carrying out normal operation Therefore, when a certain abnormalities occur in control data in a certain control unit in this case, it can judge easily whether it is what the cause depends on failure of other control units.
[0007] However, failure of the control unit of others even if it constituted the unified type control system in this way, when a cause of fault is what is depended on failure of other control units In spite of it being impossible to specify the detailed cause's of fault [say / whether it is a thing and whether they are the abnormalities of the control unit itself] depended on failure of a communication system and being able to perform the data communication between each control unit itself satisfactory When the abnormalities of control data are detected in a certain control unit, the problem that the cause of fault cannot be specified in detail remains conventionally like equipment.
[0008] That is, in case the detection data from the sensor connected to certain control unit ** are used in other control unit **s, [for example] When the abnormalities of the detection data are detected in control unit **, the cause of fault that it is in the communication system between control unit ** and control unit **, and being based on failure of the control unit ** itself -- or detailed specification of the cause of fault whether it is based on failure of the sensor connected to control unit ** is difficult
[0009] this invention was made in view of such a problem, and in the electronic control which connected through the communication wire and enabled common use of control data of two or more control units between each control unit like an above-mentioned integration type vehicles control system, when the abnormalities of control data are detected by a certain control unit, it aims at enabling it to specify the cause of fault easily and in detail.
[0010]
[Means for Solving the Problem] In the electronic control according to claim 1 made in order to attain this purpose, two or more control units which have means of communications are connected through a communication wire, and when each control unit transmits and receives a part of control data required for control of a controlled system among other control units through means of communications and a communication wire, the control data is shared with other control units. And when each control unit is equipped with a malfunction detection means to detect the abnormalities of control data used for control of a controlled system and this malfunction detection means detects the abnormalities of control data, an abnormal-condition transmitting means makes the abnormal-condition signal showing that transmit to other control units from means of communications. Moreover, if the abnormal-condition signal with which the malfunction detection means detected the abnormalities of control data, or means of communications has been transmitted from other control units is received, a data-storage means stores data in the predetermined storage which can be held continuously for the control data currently then used for control of a controlled system at the time of abnormalities.
[0011] For this reason, when a certain abnormalities occur in one of two or more control units which constitute the electronic control concerned and the abnormalities of control data are detected by the malfunction detection means, in each control unit, the control data showing the control state of the controlled system at that time will be memorized.
[0012] Therefore, when a certain abnormalities occur in the control system which consists of two or more controlled systems which each control unit controls according to this invention, from the control data memorized by the storage of each control unit, the operating state of the whole control system at the time of the heterology can be grasped, and a failure generating cause can be specified easily and in

detail.
[0013] If the abnormal-condition signal with which the abnormalities of control data were detected with the malfunction detection means, or means of communications has been transmitted from other control units is received, although a data-storage means will memorize the control data currently used for control of a controlled system here at the time of abnormalities As this control data to memorize, before means of communications receives an abnormal-condition signal, as for - rear stirrup according to claim 2 before a malfunction detection means detects abnormalities like, it is desirable to memorize the control data after - to a storage.
[0014] That is, if it does in this way, before the abnormalities of control data are detected with one malfunction detection means of two or more control units, the operating state of the whole control system after - can be grasped, and a failure generating cause can be specified more simply and with high precision from change of the operating state of each part of a control system malfunction detection before and after malfunction detection.
[0015] Moreover, when two or more control units distribute, respectively and control each part, such as an engine according to claim 3 carried in vehicles, a change gear, and a brake gear, like, if the electronic control of this invention is applied to the so-called integration type vehicles control system which realizes integrated control of vehicles, it is more effective.
[0016] that is, in the control system which performs vehicles control Since it is used under the severe condition in which external instruments, such as a control unit, sensors which are connected to this, and actuators, receive greatly the influence of external environments, such as temperature, humidity, and vibration Although it is easy to generate failure, and the cause of fault is moreover also various and failure occurs in many cases only under a specific service condition, according to this invention Since such various causes of fault can be synthetically judged from the operating state of each control unit which carries out integrated control of the vehicles, specification of a cause of fault can specify a cause of fault also to the difficult abnormalities conventionally. And for example, the effect that a substitute part can be lessened is also conventionally acquired by specifying a cause of fault for what had exchanged the parts of a large number considered to be causes of fault at the time of a certain heterology as a detail more.
[0017]
[Embodiments of the Invention] The example of this invention is explained with a drawing below. Drawing 1 is an outline block diagram showing the composition of the whole control system for vehicles of an example with which this invention was applied.
[0018] As shown in drawing 1 , the control system for vehicles of this example is formed in the automobile carrying the 8 cylinder engine (only henceforth an engine) 1 of V types, and consists of two or more control units for carrying out integrated control of each part of an automobile. Namely, the control system for vehicles of this example Open and close the throttle valve 5 prepared in the inhalation-of-air system for a left 4-cylinder (left bank) of an engine 1. The amount of inhalation of air The fuel oil consumption of the throttle control to control and a left bank, ignition timing, etc. The electronic control 10 for left bank engines which performs transmission control which controls the gear ratio of the transmission 3 which transmits power to the right-and-left driving wheel 9 etc. from the left bank engine control to control and an engine 1 (ECU for left bank engines), Open and close the throttle valve 7 prepared in the inhalation-of-air system for a right 4-cylinder (right bank) of an engine 1. The electronic control 20 for right bank engines which performs right bank engine control which controls the fuel oil consumption of the throttle control which controls the amount of inhalation of air, and a right bank, ignition timing, etc. (ECU for right bank engines), It is based on a detecting signal etc. from vehicle speed sensor 12e prepared in the power transfer system from transmission 3 to a driving wheel 9 side. The electronic control 30 for meter which performs meter control which displays the various detection data showing rolling-stock-run states, such as the vehicle speed, on the display panel 32 which consists of various meter in which it was prepared by the driver's seat (ECU for meter), While performing brake control which controls the brake gear which detected the slip state of all the wheels that contain a driving wheel 9 or a driving wheel 9 at the time of vehicles acceleration and braking, and

was formed in each wheel The electronic control 40 traction control (tanned red blood cell) and for antiskid controls (ABS) which performs suppression instructions of an engine torque to each ECUs 10 and 20 for engines if needed (ECU for ABS-tanned red blood cell), It consists of communication lines 50 for data communication which connect each [these] ECUs 10-40 mutually.

[0019] Next, the composition of each above-mentioned ECUs 10-40 is explained in detail taking the case of ECU10 for left bank engines. As shown in drawing 2 , ECU10 for left bank engines is equipped with the input interface 62 and the output interface 64 which were connected to CPU60 through the bus 66 while it is equipped with the one-chip microcomputer (only henceforth CPU) 60 which consists of CPU, a ROM, RAM, etc. as a control processing means. In addition, CPU60 is equipped with memory (for example, storages, such as Backup RAM) 60a to which after power supply interception can hold data as one of the memory which memorizes a control program or memorizes operation data temporarily.

[0020] To the input interface 62, moreover, for example, engine angle-of-rotation sensor 12a which detects the angle-of-rotation position of an engine, Accelerator position sensor 12b which detects the treading-in position of an accelerator pedal, The sensor group 12 which consists of vehicle speed sensor 12e which detects the speed of brake position sensor 12d which detects throttle opening sensor 12c which detects the opening of a throttle valve 5, and the treading-in position of a brake pedal, and vehicles, For example, starting-switch 14a which detects engine starting (cranking) by the starter motor, The switch group 14 which consists of shift-lever switch 14b which detects a shift-lever position is connected, and the input interface 62 incorporates the various detecting signals from these sensor group 12 and the switch group 14, and inputs them into CPU60.

[0021] To the output interface 64, moreover, for example, throttle drive-motor 16a which controls the opening position of a throttle valve 5, Ignition 16c which induction of the high voltage is carried out [c] to the ignition coil of injector 16b which carries out injection supply of the fuel, and a left bank on the left bank of an engine 1, and makes the ignition plug of each cylinder generate ignition sparks, The actuator group 16 which consists of solenoid-valve 16d for gear change which controls the gear ratio of transmission 3 is connected, and the output interface 64 outputs the control signal from CPU60 to each part which constitutes the actuator group 16.

[0022] And CPU60 is based on a detecting signal from the sensor group 12 inputted through the input interface 62, and the switch group 14. While calculating the various detection data (an engine speed, accelerator pedal position, etc.) in which the operational status of vehicles is shown The data (the controlled variable of throttle drive-motor 16a, fuel oil consumption, ignition MAG, gear stage of an automatic transmission, etc.) showing the controlled variable for carrying out drive control of the actuator group 16 are calculated. The control signal corresponding to the operation data is outputted to the actuator group 16 through the output interface 64.

[0023] Moreover, ECU10 for left bank engines is equipped with the communications control circuit 70 as means of communications which performs data communication through a communication line 50 among other ECUs 20, 30, and 40. It is transmitted from memory 70a for transmission which accumulates the **** transmit data shown in drawing 3 (a) transmitted from CPU60, and other ECUs 20-40, and the communications control circuit 70 has memory 70b for reception which accumulates the **** received data shown in drawing 3 (b) which received.

[0024] and within ECU10 for left bank engines While CPU60 makes transmit data the various control data which should be transmitted to other ECUs 20-40 and storing in memory 70a for transmission through the data transfer line 72 It is received in the communications control circuit 70, the received data from other ECUs 20-40 accumulated at memory 70b for reception are incorporated through the data transfer line 72, and the incorporated received data are used for the operation of a controlled variable etc. as one of the control data. Moreover, the communications control circuit 70 receives transmit data from other ECUs 20-40, and stores the received data in memory 70b for reception while it transmits the transmit data accumulated at memory 70a for transmission to other ECUs 20-40 according to the communications protocol set up beforehand.

[0025] As shown in drawing 3 (a), in addition, CPU60 It adds to the various control data DX2 and DX3,

such as engine-speed data which should be transmitted to other ECUs 20-40, and engine-cooling-water ** data, and --. The state signal DX 1 showing normal and the abnormalities of various control data, such as detection data and operation data of a controlled variable, computed based on the various above-mentioned detecting signals is made to be stored as transmit data by memory 70a for transmission, and this state signal DX 1 is transmitted to other ECUs 20-40.

[0026] Moreover, they perform data communication among other ECUs while other ECUs 20-40 have the same composition as ECU10 for left bank engines, and abbreviation, equip each with CPU60 or communications control circuit 70 grade, incorporate the detecting signal from the sensor group 12 or the switch group 14 connected to the input interface 62, calculate the controlled variable of the actuator group 16 connected to the output interface 64 and control the actuator group 16. Moreover, ECUs 20-40 besides these are also made to be transmitted to other ECUs which store the state signal DX 1 showing normal and the abnormalities of control data in memory 70a for transmission, and contain ECU10 for left bank engines from the communications control circuit 70 by operation of CPU60 like ECU10 for left bank engines.

[0027] In each ECUs 10-40 therefore, to memory 70for reception b of the communications control circuit 70 for example, the various control data DR2 (drawing expresses the throttle opening demand data transmitted to ECU40 for ABS-tanned red blood cell to ECU10 for left bank engines for engine-torque suppression) and -- which have been transmitted from other ECUs as shown in drawing 3 (b) -- in addition The state signal DR1 showing normal and the abnormalities of the control data by the side of other ECUs will also be stored as received data.

[0028] And in the data communication between each ECU 10-40, through the communications control circuit 70 and a communication line 50, it is transmitted to ECU30 for meter, and the engine-speed data calculated as one of the control data by ECU10 for left bank engines use this engine-speed data for the drive of a tachometer by ECU30 for meter.

[0029] That is, each ECUs 10-40 receive a part of control data required for control from other ECUs by the data communication using the communications control circuit 70 and the communication line 50, and share this control data among other ECUs. Moreover, ECU20 for right bank engines and ECU30 for meter enable it to transmit in order the vehicle speed data calculated by ECU10 for left bank engines in the control system for vehicles of this example using the signal line 52 of exclusive use with an another communication line 50. And this vehicle speed data is used for displaying a speedometer in ECU30 for meter while it is used for performing fixed-speed run control of vehicles in ECU20 for right bank engines.

[0030] In addition, in the data communication for which this used the communications control circuit 70 and the communication line 50, the addition operation of mileage is difficult, or the vehicle speed data inputted through the signal line 52 when it was made [it being necessary to double a data transmitting system about important control data, such as vehicle speed data,] and a speedometer was displayed in ECU30 for meter are used. And in case it transmits through the signal line 52 of exclusive use of vehicle speed data etc. in this way, CPU60 the very thing functions as means of communications.

[0031] Next, the state signal setting processing for transmitting the control processing performed in order to perform various control in each above-mentioned ECUs 10-40, and the state signal with which the abnormalities of control data are judged and a local station (self-ECU) expresses a normal state or an abnormal condition at the time of the control processing execution to other ECUs is explained using the flow chart of drawing 4 and drawing 5 . In addition, the flow chart shown in drawing 4 and drawing 5 expresses roughly the flow of the processing which CPU60 prepared in each ECUs 10-40 performs, and changes respectively with the kind of controlled system, contents of control, etc. in a detail more.

[0032] As shown in drawing 4 , it sets to each ECUs 10-40. CPU60 In S110 (S: -- a step is expressed), the various detecting signals from the sensor group 12 and the switch group 14 are read first. Calculate detection data and received data are read from memory 70for reception b in the communications control circuit 70 in S120 continuing. It is based on the detection data calculated in S130 continuing S110, and the received data read in S120. Compute the various controlled variables for realizing predetermined control, and the control signal according to the computed controlled variable is outputted to the actuator

group 16 in S140. The inside of the operation data which express the controlled variable calculated in the detection data for which it asked in S110, or S130 with S150 which drives various actuators and continues further, Control processing for controlled-system control is performed by repeating and performing processing of S110-S150 in the procedure of storing in memory 70a for transmission in the communications control circuit 70 the control data for transmission which should be transmitted to other ECUs, and shifting to S110 again.

[0033] Moreover, there may be abnormalities in the result of an operation (operation data) of the controlled variable calculated from the detection data calculated from the detecting signal, and the received data read from memory 70for reception b or these control data at the time of a series of such control processing execution etc. Then, at the time of execution of the above S110-S130, state signal setting processing which sets to memory 70a for transmission of the communications control circuit 70 the state signal with which normal and the abnormalities of each control data are judged, and the judgment result is expressed as one of the transmit data to other ECUs is performed collectively.

[0034] As this state signal setting processing is shown in drawing 5 , abnormalities, such as detection data first obtained in S210 at the time of execution of the above S110-S130, received data, and operation data, are judged. For example, in case it judges whether the control data searched for from the detecting signal itself or the detecting signal is outlying observation in case detection data are calculated based on the detecting signal from the sensor group 12 or the switch group 14 in S110 and received data are read in S120, it judges whether the abnormal-condition signal showing the abnormalities by the side of other ECUs exists in received data, or the control data in received data has become outlying observation.

[0035] And if a certain abnormalities are detected in S210, before detecting the abnormality in S220 continuing, processing as a data-storage means is performed at the time of the above-mentioned abnormalities which store in memory 60a all the normal control data when using it by control processing, and all the control data at present that detected abnormalities, and it shifts to S230 continuing. In addition, in these S220, it shifts to S230, without performing storing processing of control data, when the abnormalities same at S210 are detected continuously and the control data of before detection and [the] the back is already stored in memory 60a.

[0036] Next, in S230, the abnormalities detected this time judge whether it is what is depended on the abnormal-condition signal included in the received data from other ECUs. And if not based on an abnormal-condition signal from other ECUs, the abnormalities detected this time judge it as what abnormalities generated in the ECU side concerned, in order to report the purport which abnormalities generated in self-ECU S240 to other ECUs, will set an abnormal-condition signal to memory 70a for transmission, and will end the processing concerned.

[0037] When abnormalities are undetectable in S210 on the other hand, or when the abnormalities detected in S220 this time are based on an abnormal-condition signal from other ECUs and it judges with self-ECU being normal, it shifts to S250, and self-ECU sets a normal-state signal to other ECUs at memory 70a for transmission, in order to report the purport which is a normal state, and the processing concerned is ended.

[0038] As explained above, in the control system for vehicles of this example, the operating state of self-ECU is made to be reported to each ECUs 10-40 connected through the communication line 50 by judging normal and the abnormalities of control data, and setting the normal-state signal or abnormal-condition signal according to the judgment result to memory 70a for transmission in the communications control circuit 70 to other ECUs. And each ECUs 10-40 store all the control data acquired before detection and [the] in the back in memory 60a of CPU60, if the abnormalities of other ECUs are detected from the abnormal-condition signal which detected the abnormalities of self-ECU or has been transmitted from other ECUs.

[0039] For this reason, in the control system for vehicles of this example, when a certain abnormalities occur, it becomes possible to grasp the operational status of the vehicles at that time in detail, and to specify a cause of fault easily and in detail from the control data before and behind the malfunction detection stored in memory 60a of each ECUs 10-40.

[0040] For example, when the abnormalities in a display of a speedometer occur, a locating fault can be

pinpointed simply and in detail in the failure analysis procedure explained below. First, with the control system of this example, once, the detecting signal (vehicle speed signal) from vehicle speed sensor 12e is incorporated by ECU10 for left bank engines, and is changed into vehicle speed data. And in case it is transmitted to other ECUs 20-40 through a communication line 50 and the signal line 52 of exclusive use from ECU10 for left bank engines and ECU30 for meter displays a speedometer, the vehicle speed data inputted through the signal line 52 are used for this vehicle speed data.

[0041] It is thought that a certain abnormalities occurred on the signal path of the vehicle speed data shown in drawing 6 when the abnormalities in a display of a speedometer occurred. therefore, as the cause of fault The abnormalities of the vehicle speed sensor 12e itself, An open circuit of the signal line loop splice plate from vehicle speed sensor 12e to ECU10 for left bank engines, an open circuit of signal-line 52a from ECU10 for left bank engines to ECU20 for right bank engines, an open circuit of signal-line 52b from ECU20 for right bank engines to ECU30 for meter, Signal line LM from ECU30 for meter to speedometer 32a Failure of an open circuit and the speedometer 32a itself etc. can be considered. In addition, although the abnormalities in a display of a speedometer occur in fact when either of ECUs 10-30 breaks down, since not only the abnormalities in a display of a speedometer but other abnormalities are simultaneously caused in this case, in order to simplify explanation, suppose that reference is not made about the abnormalities of each ECU here.

[0042] and in the case of the abnormalities by failure of the vehicle speed sensor 12e itself, or open circuit of a signal line loop splice plate Since normal vehicle speed data are not obtained in all ECUs, the abnormalities of vehicle speed data are detected in each ECU, and, in the case of the abnormalities by open circuit of signal-line 52a From normal vehicle speed data not being inputted into ECU20 for right bank engines, and ECU30 for meter The abnormalities of vehicle speed data are detected by each [these] ECUs 20 and 30, and, in the case of the abnormalities by open circuit of signal-line 52b From normal vehicle speed data not being inputted only into ECU30 for meter The abnormalities of vehicle speed data are detected only by ECU30 for meter, and it is a signal line LM. In the case of the abnormalities by failure of an open circuit or the speedometer 32a itself, since normal vehicle speed data are inputted into all ECUs, as for the abnormalities of vehicle speed data, neither of the ECUs is detected. Moreover, when the abnormalities of vehicle speed data are detected in each ECU, that is reported to all ECUs by the abnormal-condition signal, and all the control data at that time are stored in memory 60a of each ECU.

[0043] Therefore, when the abnormalities in a display of speedometer 32a occur, a failure part can be pinpointed in the procedure shown in drawing 7 by using the control data at the time of the malfunction detection memorized by ECU30 for meter. As shown in drawing 7 , it checks whether the control data (henceforth the 1st abnormality information) memorized when self-ECU30 detected the abnormalities of vehicle speed data in ECU30 for meter exists (S310). And if this 1st abnormality information is not memorized by ECU30 for meter, they are the speedometer 32a itself or a signal line LM. Signal line LM since it is abnormalities It checks whether there are any abnormalities, such as an open circuit, (S320), the check result is followed, and they are speedometer 32a or a signal line LM. Abnormalities are specified (S330, S340).

[0044] On the other hand, when the 1st abnormality information is memorized by ECU30 for meter, it checks whether the control data (henceforth the 2nd abnormality information) memorized when ECU20 for right bank engines detected the abnormalities of vehicle speed data in ECU30 for meter exists (S350). And if the 2nd abnormality information is not memorized by ECU30 for meter, the abnormalities of signal-line 52b are specified (S360).

[0045] Moreover, when the 2nd abnormality information is memorized by ECU30 for meter, it checks whether the control data (henceforth the 3rd abnormality information) memorized when ECU10 for left bank engines detected the abnormalities of vehicle speed data in ECU30 for meter exists (S370). And if the 3rd abnormality information is not memorized by ECU30 for meter, the abnormalities of signal-line 52a are specified (S380).

[0046] Furthermore, when the 3rd abnormality information is memorized by ECU30 for meter, since a signal line loop splice plate or the vehicle speed sensor 12e itself is unusual, it checks whether

abnormalities, such as an open circuit, are in a signal line loop splice plate (S390), and the abnormalities of a signal line loop splice plate or vehicle speed sensor 12e are specified according to the check result (S400, S410).

[0047] thus, when according to the control system for vehicles of this example performing various control, such as abnormalities in a display of a speedometer, and a certain abnormalities occur Since all control data before and after the abnormality occurred in memory 60a of each ECUs 10-40 are memorized, in case repair or check is performed From the control data at the time of the malfunction detection memorized by each ECUs 10-40, a vehicles state can be grasped in detail and a cause of fault can be specified now easily and in detail.

[0048] In addition, although the above-mentioned explanation explained taking the case of the analysis procedure at the time of the display heterology of the speedometer which can be performed comparatively easily as an analysis procedure at the time of pinpointing a failure part, if this invention is used, not only using the time of the display heterology of such a speedometer but using the control data at the time of what malfunction detection memorized by each ECUs 10-40 even if unusual, failure analysis is performed and a failure part can be pinpointed. Moreover, although the above-mentioned explanation explained the case where failure analysis at the time of the abnormalities in a speedometer display was performed, using the control data memorized by ECU30 for meter, such failure analysis can be similarly performed, even if it uses the control data memorized by which ECU. Therefore, failure analysis can be correctly performed using the control data memorized by other ECUs though specific ECU broke down among ECUs temporarily connected to the communication line 50.

[0049] And if abnormalities are detected by one of ECUs, since all ECUs connected to the communication line 50 will memorize all the control data then used for control according to this example, if these all control data is analyzed, the operational status of the vehicles at the time of a heterology can be grasped in detail. When it follows, for example, tanned-red-blood-cell control is carried out, it is [be / effective in the failure analysis in the limited operational status of being in an abnormal condition / it] needless to say in a bird clapper.

[0050] Moreover, although CPU60 was only explained in each ECUs 10-40 in the above-mentioned example as what memorizes all the control data before and behind the malfunction detection when self-ECU or other ECUs detected abnormalities If all the control data before and behind malfunction detection are memorized one by one over multiple times, the chronological-order foreword of abnormalities when abnormalities occur continuously in each ECUs 10-40 can be known now, and it will become possible to specify a cause of fault more efficiently.

[0051] Furthermore, although the above-mentioned example explained the case where this invention was applied to the control system for vehicles, this invention connects two or more control units in a communication wire, if it is the electronic control (system) with which each control unit shared a part of control data, can be applied like the above-mentioned example and can acquire the same effect.

[Translation done.]

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TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to the electronic control constituted so that this control data might be shared between each control unit by transmitting and receiving a part of control data required for control of a controlled system through a communication wire among two or more control units.

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PRIOR ART

[Description of the Prior Art] With the engine control system for vehicles from the former When abnormalities arise to the detection data computed based on the detecting signal from a sensor which detects the operational status of vehicles, the operation data which calculated controlled variables, such as fuel oil consumption and ignition timing, according to the detection data, what memorized these all control data to the predetermined storage to which stored data does not disappear by power supply interception etc. is known.
[0003] This is because the vehicles state at the time of unusual generating is grasped from the control data which carried out [above-mentioned] storage and a cause of fault can be specified easily, when it fits memorizing the engine control state at the time of for example, an emission associated part breaking down an engine control system (frieze frame) to the California onboard DAIAGU (OBD) regulation which specified and abnormalities occur in an engine control system.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, by the conventional method which memorizes the control data at the time of malfunction detection by the engine-control-system independent, since the control data to memorize was restricted to the data of an engine control system, from the stored data, it is difficult to grasp the whole vehicles state at the time of malfunction detection, and a cause of fault was not able to be specified in detail and with high precision. For example, although it is necessary to grasp correctly the rolling-stock-run state at the time of malfunction detection in order to specify the cause of fault when abnormalities occur in control data only under the run conditions of the specification of vehicles called the time of vehicles braking at the time of vehicles acceleration, even if it memorizes the control data at the time of malfunction detection by the engine-control-system independent, a cause of fault cannot be specified from the stored data.
[0005] moreover, with the control system for vehicles, especially in recent years For example, each [these] control unit is connected by the communication wire from the control system of the so-called standalone version with which the control unit of exclusive use performs respectively independently control to each controlled systems, such as engine control, transmission control, and brake control. Although each control unit is shifting to the so-called integration type control system which shares control data and controls vehicles synthetically by transmitting and receiving control data between each control unit In such a unified type control system, like before, even if an engine control system etc. memorizes the control data at the time of malfunction detection by each control unit independent Grasping the vehicles state at the time of malfunction detection from the stored data, specifying a cause of fault has the problem of becoming still more difficult.
[0006] On the other hand, if a certain computer detects the abnormalities of other computers from the result of data communication conventionally in the communication system which performs data communication among two or more computers as indicated by JP,3-184154,A, the communication system which enabled it to perform data communication between each computer efficiently is known by forbidding the data communication to the computer which reported that to the remaining computers and abnormalities generated after that. and when applying such technology to the above-mentioned integration type control system and either of other control units detects the abnormalities of the specific control unit which constitutes this control system, what is made to report and memorize that is made to all the control units that are carrying out normal operation Therefore, when a certain abnormalities occur in control data in a certain control unit in this case, it can judge easily whether it is what the cause depends on failure of other control units.
[0007] However, failure of the control unit of others even if it constituted the unified type control system in this way, when a cause of fault is what is depended on failure of other control units In spite of it being impossible to specify the detailed cause's of fault [say / whether it is a thing and whether they are the abnormalities of the control unit itself] depended on failure of a communication system and being able to perform the data communication between each control unit itself satisfactory When the abnormalities of control data are detected in a certain control unit, the problem that the cause of fault cannot be specified in detail remains conventionally like equipment.

[0008] That is, in case the detection data from the sensor connected to certain control unit ** are used in other control unit **s, [for example] When the abnormalities of the detection data are detected in control unit **, the cause of fault that it is in the communication system between control unit ** and control unit **, and being based on failure of the control unit ** itself -- or detailed specification of the cause of fault whether it is based on failure of the sensor connected to control unit ** is difficult
[0009] this invention was made in view of such a problem, and in the electronic control which connected through the communication wire and enabled common use of control data of two or more control units between each control unit like an above-mentioned integration type vehicles control system, when the abnormalities of control data are detected by a certain control unit, it aims at enabling it to specify the cause of fault easily and in detail.

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MEANS

[Means for Solving the Problem] In the electronic control according to claim 1 made in order to attain this purpose, two or more control units which have means of communications are connected through a communication wire, and when each control unit transmits and receives a part of control data required for control of a controlled system among other control units through means of communications and a communication wire, the control data is shared with other control units. And when each control unit is equipped with a malfunction detection means to detect the abnormalities of control data used for control of a controlled system and this malfunction detection means detects the abnormalities of control data, an abnormal-condition transmitting means makes the abnormal-condition signal showing that transmit to other control units from means of communications. Moreover, if the abnormal-condition signal with which the malfunction detection means detected the abnormalities of control data, or means of communications has been transmitted from other control units is received, a data-storage means stores data in the predetermined storage which can be held continuously for the control data currently then used for control of a controlled system at the time of abnormalities.
[0011] For this reason, when a certain abnormalities occur in one of two or more control units which constitute the electronic control concerned and the abnormalities of control data are detected by the malfunction detection means, in each control unit, the control data showing the control state of the controlled system at that time will be memorized.
[0012] Therefore, when a certain abnormalities occur in the control system which consists of two or more controlled systems which each control unit controls according to this invention, from the control data memorized by the storage of each control unit, the operating state of the whole control system at the time of the heterology can be grasped, and a failure generating cause can be specified easily and in detail.
[0013] If the abnormal-condition signal with which the abnormalities of control data were detected with the malfunction detection means, or means of communications has been transmitted from other control units is received, although a data-storage means will memorize the control data currently used for control of a controlled system here at the time of abnormalities As this control data to memorize, before means of communications receives an abnormal-condition signal, as for - rear stirrup according to claim 2 before a malfunction detection means detects abnormalities like, it is desirable to memorize the control data after - to a storage.
[0014] That is, if it does in this way, before the abnormalities of control data are detected with one malfunction detection means of two or more control units, the operating state of the whole control system after - can be grasped, and a failure generating cause can be specified more simply and with high precision from change of the operating state of each part of a control system malfunction detection before and after malfunction detection.
[0015] Moreover, when two or more control units distribute, respectively and control each part, such as an engine according to claim 3 carried in vehicles, a change gear, and a brake gear, like, if the electronic control of this invention is applied to the so-called integration type vehicles control system which realizes integrated control of vehicles, it is more effective.

[0016] that is, in the control system which performs vehicles control Since it is used under the severe condition in which external instruments, such as a control unit, sensors which are connected to this, and actuators, receive greatly the influence of external environments, such as temperature, humidity, and vibration Although it is easy to generate failure, and the cause of fault is moreover also various and failure occurs in many cases only under a specific service condition, according to this invention Since such various causes of fault can be synthetically judged from the operating state of each control unit which carries out integrated control of the vehicles, specification of a cause of fault can specify a cause of fault also to the difficult abnormalities conventionally. And for example, the effect that a substitute part can be lessened is also conventionally acquired by specifying a cause of fault for what had exchanged the parts of a large number considered to be causes of fault at the time of a certain heterology as a detail more.

[0017]

[Embodiments of the Invention] The example of this invention is explained with a drawing below. Drawing 1 is an outline block diagram showing the composition of the whole control system for vehicles of an example with which this invention was applied.

[0018] As shown in drawing 1 , the control system for vehicles of this example is formed in the automobile carrying the 8 cylinder engine (only henceforth an engine) 1 of V types, and consists of two or more control units for carrying out integrated control of each part of an automobile. Namely, the control system for vehicles of this example Open and close the throttle valve 5 prepared in the inhalation-of-air system for a left 4-cylinder (left bank) of an engine 1. The amount of inhalation of air The fuel oil consumption of the throttle control to control and a left bank, ignition timing, etc. The electronic control 10 for left bank engines which performs transmission control which controls the gear ratio of the transmission 3 which transmits power to the right-and-left driving wheel 9 etc. from the left bank engine control to control and an engine 1 (ECU for left bank engines), Open and close the throttle valve 7 prepared in the inhalation-of-air system for a right 4-cylinder (right bank) of an engine 1. The electronic control 20 for right bank engines which performs right bank engine control which controls the fuel oil consumption of the throttle control which controls the amount of inhalation of air, and a right bank, ignition timing, etc. (ECU for right bank engines), It is based on a detecting signal etc. from vehicle speed sensor 12e prepared in the power transfer system from transmission 3 to a driving wheel 9 side. The electronic control 30 for meter which performs meter control which displays the various detection data showing rolling-stock-run states, such as the vehicle speed, on the display panel 32 which consists of various meter in which it was prepared by the driver's seat (ECU for meter), While performing brake control which controls the brake gear which detected the slip state of all the wheels that contain a driving wheel 9 or a driving wheel 9 at the time of vehicles acceleration and braking, and was formed in each wheel The electronic control 40 traction control (tanned red blood cell) and for antiskid controls (ABS) which performs suppression instructions of an engine torque to each ECUs 10 and 20 for engines if needed (ECU for ABS-tanned red blood cell), It consists of communication lines 50 for data communication which connect each [these] ECUs 10-40 mutually.

[0019] Next, the composition of each above-mentioned ECUs 10-40 is explained in detail taking the case of ECU10 for left bank engines. As shown in drawing 2 , ECU10 for left bank engines is equipped with the input interface 62 and the output interface 64 which were connected to CPU60 through the bus 66 while it is equipped with the one-chip microcomputer (only henceforth CPU) 60 which consists of CPU, a ROM, RAM, etc. as a control processing means. In addition, CPU60 is equipped with memory (for example, storages, such as Backup RAM) 60a to which after power supply interception can hold data as one of the memory which memorizes a control program or memorizes operation data temporarily.

[0020] To the input interface 62, moreover, for example, engine angle-of-rotation sensor 12a which detects the angle-of-rotation position of an engine, Accelerator position sensor 12b which detects the treading-in position of an accelerator pedal, The sensor group 12 which consists of vehicle speed sensor 12e which detects the speed of brake position sensor 12d which detects throttle opening sensor 12c which detects the opening of a throttle valve 5, and the treading-in position of a brake pedal, and

vehicles, For example, starting-switch 14a which detects engine starting (cranking) by the starter motor, The switch group 14 which consists of shift-lever switch 14b which detects a shift-lever position is connected, and the input interface 62 incorporates the various detecting signals from these sensor group 12 and the switch group 14, and inputs them into CPU60.

[0021] To the output interface 64, moreover, for example, throttle drive-motor 16a which controls the opening position of a throttle valve 5, Ignition 16c which induction of the high voltage is carried out [c] to the ignition coil of injector 16b which carries out injection supply of the fuel, and a left bank on the left bank of an engine 1, and makes the ignition plug of each cylinder generate ignition sparks, The actuator group 16 which consists of solenoid-valve 16d for gear change which controls the gear ratio of transmission 3 is connected, and the output interface 64 outputs the control signal from CPU60 to each part which constitutes the actuator group 16.

[0022] And CPU60 is based on a detecting signal from the sensor group 12 inputted through the input interface 62, and the switch group 14. While calculating the various detection data (an engine speed, accelerator pedal position, etc.) in which the operational status of vehicles is shown The data (the controlled variable of throttle drive-motor 16a, fuel oil consumption, ignition MAG, gear stage of an automatic transmission, etc.) showing the controlled variable for carrying out drive control of the actuator group 16 are calculated. The control signal corresponding to the operation data is outputted to the actuator group 16 through the output interface 64.

[0023] Moreover, ECU10 for left bank engines is equipped with the communications control circuit 70 as means of communications which performs data communication through a communication line 50 among other ECUs 20, 30, and 40. It is transmitted from memory 70a for transmission which accumulates the **** transmit data shown in drawing 3 (a) transmitted from CPU60, and other ECUs 20-40, and the communications control circuit 70 has memory 70b for reception which accumulates the **** received data shown in drawing 3 (b) which received.

[0024] and within ECU10 for left bank engines While CPU60 makes transmit data the various control data which should be transmitted to other ECUs 20-40 and storing in memory 70a for transmission through the data transfer line 72 It is received in the communications control circuit 70, the received data from other ECUs 20-40 accumulated at memory 70b for reception are incorporated through the data transfer line 72, and the incorporated received data are used for the operation of a controlled variable etc. as one of the control data. Moreover, the communications control circuit 70 receives transmit data from other ECUs 20-40, and stores the received data in memory 70b for reception while it transmits the transmit data accumulated at memory 70a for transmission to other ECUs 20-40 according to the communications protocol set up beforehand.

[0025] As shown in drawing 3 (a), in addition, CPU60 It adds to the various control data DX2 and DX3, such as engine-speed data which should be transmitted to other ECUs 20-40, and engine-cooling-water ** data, and --. The state signal DX 1 showing normal and the abnormalities of various control data, such as detection data and operation data of a controlled variable, computed based on the various above-mentioned detecting signals is made to be stored as transmit data by memory 70a for transmission, and this state signal DX 1 is transmitted to other ECUs 20-40.

[0026] Moreover, they perform data communication among other ECUs while other ECUs 20-40 have the same composition as ECU10 for left bank engines, and abbreviation, equip each with CPU60 or communications control circuit 70 grade, incorporate the detecting signal from the sensor group 12 or the switch group 14 connected to the input interface 62, calculate the controlled variable of the actuator group 16 connected to the output interface 64 and control the actuator group 16. Moreover, ECUs 20-40 besides these are also made to be transmitted to other ECUs which store the state signal DX 1 showing normal and the abnormalities of control data in memory 70a for transmission, and contain ECU10 for left bank engines from the communications control circuit 70 by operation of CPU60 like ECU10 for left bank engines.

[0027] In each ECUs 10-40 therefore, to memory 70for reception b of the communications control circuit 70 for example, the various control data DR2 (drawing expresses the throttle opening demand data transmitted to ECU40 for ABS-tanned red blood cell to ECU10 for left bank engines for engine-

torque suppression) and -- which have been transmitted from other ECUs as shown in drawing 3 (b) -- in addition The state signal DR1 showing normal and the abnormalities of the control data by the side of other ECUs will also be stored as received data.
[0028] And in the data communication between each ECU 10-40, through the communications control circuit 70 and a communication line 50, it is transmitted to ECU30 for meter, and the engine-speed data calculated as one of the control data by ECU10 for left bank engines use this engine-speed data for the drive of a tachometer by ECU30 for meter.
[0029] That is, each ECUs 10-40 receive a part of control data required for control from other ECUs by the data communication using the communications control circuit 70 and the communication line 50, and share this control data among other ECUs. Moreover, ECU20 for right bank engines and ECU30 for meter enable it to transmit in order the vehicle speed data calculated by ECU10 for left bank engines in the control system for vehicles of this example using the signal line 52 of exclusive use with an another communication line 50. And this vehicle speed data is used for displaying a speedometer in ECU30 for meter while it is used for performing fixed-speed run control of vehicles in ECU20 for right bank engines.
[0030] In addition, in the data communication for which this used the communications control circuit 70 and the communication line 50, the addition operation of mileage is difficult, or the vehicle speed data inputted through the signal line 52 when it was made [it being necessary to double a data transmitting system about important control data, such as vehicle speed data,] and a speedometer was displayed in ECU30 for meter are used. And in case it transmits through the signal line 52 of exclusive use of vehicle speed data etc. in this way, CPU60 the very thing functions as means of communications.
[0031] Next, the state signal setting processing for transmitting the control processing performed in order to perform various control in each above-mentioned ECUs 10-40, and the state signal with which the abnormalities of control data are judged and a local station (self-ECU) expresses a normal state or an abnormal condition at the time of the control processing execution to other ECUs is explained using the flow chart of drawing 4 and drawing 5 . In addition, the flow chart shown in drawing 4 and drawing 5 expresses roughly the flow of the processing which CPU60 prepared in each ECUs 10-40 performs, and changes respectively with the kind of controlled system, contents of control, etc. in a detail more.
[0032] As shown in drawing 4 , it sets to each ECUs 10-40. CPU60 In S110 (S: -- a step is expressed), the various detecting signals from the sensor group 12 and the switch group 14 are read first. Calculate detection data and received data are read from memory 70for reception b in the communications control circuit 70 in S120 continuing. It is based on the detection data calculated in S130 continuing S110, and the received data read in S120. Compute the various controlled variables for realizing predetermined control, and the control signal according to the computed controlled variable is outputted to the actuator group 16 in S140. The inside of the operation data which express the controlled variable calculated in the detection data for which it asked in S110, or S130 with S150 which drives various actuators and continues further, Control processing for controlled-system control is performed by repeating and performing processing of S110-S150 in the procedure of storing in memory 70a for transmission in the communications control circuit 70 the control data for transmission which should be transmitted to other ECUs, and shifting to S110 again.
[0033] Moreover, there may be abnormalities in the result of an operation (operation data) of the controlled variable calculated from the detection data calculated from the detecting signal, and the received data read from memory 70for reception b or these control data at the time of a series of such control processing execution etc. Then, at the time of execution of the above S110-S130, state signal setting processing which sets to memory 70a for transmission of the communications control circuit 70 the state signal with which normal and the abnormalities of each control data are judged, and the judgment result is expressed as one of the transmit data to other ECUs is performed collectively.
[0034] As this state signal setting processing is shown in drawing 5 , abnormalities, such as detection data first obtained in S210 at the time of execution of the above S110-S130, received data, and operation data, are judged. For example, in case it judges whether the control data searched for from the detecting signal itself or the detecting signal is outlying observation in case detection data are calculated based on

the detecting signal from the sensor group 12 or the switch group 14 in S110 and received data are read in S120, it judges whether the abnormal-condition signal showing the abnormalities by the side of other ECUs exists in received data, or the control data in received data has become outlying observation.
[0035] And if a certain abnormalities are detected in S210, before detecting the abnormality in S220 continuing, processing as a data-storage means is performed at the time of the above-mentioned abnormalities which store in memory 60a all the normal control data when using it by control processing, and all the control data at present that detected abnormalities, and it shifts to S230 continuing. In addition, in these S220, it shifts to S230, without performing storing processing of control data, when the abnormalities same at S210 are detected continuously and the control data of before detection and [the] the back is already stored in memory 60a.
[0036] Next, in S230, the abnormalities detected this time judge whether it is what is depended on the abnormal-condition signal included in the received data from other ECUs. And if not based on an abnormal-condition signal from other ECUs, the abnormalities detected this time judge it as what abnormalities generated in the ECU side concerned, in order to report the purport which abnormalities generated in self-ECU S240 to other ECUs, will set an abnormal-condition signal to memory 70a for transmission, and will end the processing concerned.
[0037] When abnormalities are undetectable in S210 on the other hand, or when the abnormalities detected in S220 this time are based on an abnormal-condition signal from other ECUs and it judges with self-ECU being normal, it shifts to S250, and self-ECU sets a normal-state signal to other ECUs at memory 70a for transmission, in order to report the purport which is a normal state, and the processing concerned is ended.
[0038] As explained above, in the control system for vehicles of this example, the operating state of self-ECU is made to be reported to each ECUs 10-40 connected through the communication line 50 by judging normal and the abnormalities of control data, and setting the normal-state signal or abnormal-condition signal according to the judgment result to memory 70a for transmission in the communications control circuit 70 to other ECUs. And each ECUs 10-40 store all the control data acquired before detection and [the] in the back in memory 60a of CPU60, if the abnormalities of other ECUs are detected from the abnormal-condition signal which detected the abnormalities of self-ECU or has been transmitted from other ECUs.
[0039] For this reason, in the control system for vehicles of this example, when a certain abnormalities occur, it becomes possible to grasp the operational status of the vehicles at that time in detail, and to specify a cause of fault easily and in detail from the control data before and behind the malfunction detection stored in memory 60a of each ECUs 10-40.
[0040] For example, when the abnormalities in a display of a speedometer occur, a locating fault can be pinpointed simply and in detail in the failure analysis procedure explained below. First, with the control system of this example, once, the detecting signal (vehicle speed signal) from vehicle speed sensor 12e is incorporated by ECU10 for left bank engines, and is changed into vehicle speed data. And in case it is transmitted to other ECUs 20-40 through a communication line 50 and the signal line 52 of exclusive use from ECU10 for left bank engines and ECU30 for meter displays a speedometer, the vehicle speed data inputted through the signal line 52 are used for this vehicle speed data.
[0041] It is thought that a certain abnormalities occurred on the signal path of the vehicle speed data shown in drawing 6 when the abnormalities in a display of a speedometer occurred. therefore, as the cause of fault The abnormalities of the vehicle speed sensor 12e itself, An open circuit of the signal line loop splice plate from vehicle speed sensor 12e to ECU10 for left bank engines, an open circuit of signal-line 52a from ECU10 for left bank engines to ECU20 for right bank engines, an open circuit of signal-line 52b from ECU20 for right bank engines to ECU30 for meter, Signal line LM from ECU30 for meter to speedometer 32a Failure of an open circuit and the speedometer 32a itself etc. can be considered. In addition, although the abnormalities in a display of a speedometer occur in fact when either of ECUs 10-30 breaks down, since not only the abnormalities in a display of a speedometer but other abnormalities are simultaneously caused in this case, in order to simplify explanation, suppose that reference is not made about the abnormalities of each ECU here.

[0042] and in the case of the abnormalities by failure of the vehicle speed sensor 12e itself, or open circuit of a signal line loop splice plate Since normal vehicle speed data are not obtained in all ECUs, the abnormalities of vehicle speed data are detected in each ECU, and, in the case of the abnormalities by open circuit of signal-line 52a From normal vehicle speed data not being inputted into ECU20 for right bank engines, and ECU30 for meter The abnormalities of vehicle speed data are detected by each [these] ECUs 20 and 30, and, in the case of the abnormalities by open circuit of signal-line 52b From normal vehicle speed data not being inputted only into ECU30 for meter The abnormalities of vehicle speed data are detected only by ECU30 for meter, and it is a signal line LM. In the case of the abnormalities by failure of an open circuit or the speedometer 32a itself, since normal vehicle speed data are inputted into all ECUs, as for the abnormalities of vehicle speed data, neither of the ECUs is detected. Moreover, when the abnormalities of vehicle speed data are detected in each ECU, that is reported to all ECUs by the abnormal-condition signal, and all the control data at that time are stored in memory 60a of each ECU.

[0043] Therefore, when the abnormalities in a display of speedometer 32a occur, a failure part can be pinpointed in the procedure shown in drawing 7 by using the control data at the time of the malfunction detection memorized by ECU30 for meter. As shown in drawing 7 , it checks whether the control data (henceforth the 1st abnormality information) memorized when self-ECU30 detected the abnormalities of vehicle speed data in ECU30 for meter exists (S310). And if this 1st abnormality information is not memorized by ECU30 for meter, they are the speedometer 32a itself or a signal line LM. Signal line LM since it is abnormalities It checks whether there are any abnormalities, such as an open circuit, (S320), the check result is followed, and they are speedometer 32a or a signal line LM. Abnormalities are specified (S330, S340).

[0044] On the other hand, when the 1st abnormality information is memorized by ECU30 for meter, it checks whether the control data (henceforth the 2nd abnormality information) memorized when ECU20 for right bank engines detected the abnormalities of vehicle speed data in ECU30 for meter exists (S350). And if the 2nd abnormality information is not memorized by ECU30 for meter, the abnormalities of signal-line 52b are specified (S360).

[0045] Moreover, when the 2nd abnormality information is memorized by ECU30 for meter, it checks whether the control data (henceforth the 3rd abnormality information) memorized when ECU10 for left bank engines detected the abnormalities of vehicle speed data in ECU30 for meter exists (S370). And if the 3rd abnormality information is not memorized by ECU30 for meter, the abnormalities of signal-line 52a are specified (S380).

[0046] Furthermore, when the 3rd abnormality information is memorized by ECU30 for meter, since a signal line loop splice plate or the vehicle speed sensor 12e itself is unusual, it checks whether abnormalities, such as an open circuit, are in a signal line loop splice plate (S390), and the abnormalities of a signal line loop splice plate or vehicle speed sensor 12e are specified according to the check result (S400, S410).

[0047] thus, when according to the control system for vehicles of this example performing various control, such as abnormalities in a display of a speedometer, and a certain abnormalities occur Since all control data before and after the abnormality occurred in memory 60a of each ECUs 10-40 are memorized, in case repair or check is performed From the control data at the time of the malfunction detection memorized by each ECUs 10-40, a vehicles state can be grasped in detail and a cause of fault can be specified now easily and in detail.

[0048] In addition, although the above-mentioned explanation explained taking the case of the analysis procedure at the time of the display heterology of the speedometer which can be performed comparatively easily as an analysis procedure at the time of pinpointing a failure part, if this invention is used, not only using the time of the display heterology of such a speedometer but using the control data at the time of what malfunction detection memorized by each ECUs 10-40 even if unusual, failure analysis is performed and a failure part can be pinpointed. Moreover, although the above-mentioned explanation explained the case where failure analysis at the time of the abnormalities in a speedometer display was performed, using the control data memorized by ECU30 for meter, such failure analysis can

be similarly performed, even if it uses the control data memorized by which ECU. Therefore, failure analysis can be correctly performed using the control data memorized by other ECUs though specific ECU broke down among ECUs temporarily connected to the communication line 50.
[0049] And if abnormalities are detected by one of ECUs, since all ECUs connected to the communication line 50 will memorize all the control data then used for control according to this example, if these all control data is analyzed, the operational status of the vehicles at the time of a heterology can be grasped in detail. When it follows, for example, tanned-red-blood-cell control is carried out, it is [be / effective in the failure analysis in the limited operational status of being in an abnormal condition / it] needless to say in a bird clapper.
[0050] Moreover, although CPU60 was only explained in each ECUs 10-40 in the above-mentioned example as what memorizes all the control data before and behind the malfunction detection when self-ECU or other ECUs detected abnormalities If all the control data before and behind malfunction detection are memorized one by one over multiple times, the chronological-order foreword of abnormalities when abnormalities occur continuously in each ECUs 10-40 can be known now, and it will become possible to specify a cause of fault more efficiently.
[0051] Furthermore, although the above-mentioned example explained the case where this invention was applied to the control system for vehicles, this invention connects two or more control units in a communication wire, if it is the electronic control (system) with which each control unit shared a part of control data, can be applied like the above-mentioned example and can acquire the same effect.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is an outline block diagram showing the composition of the control system for vehicles of an example.
[Drawing 2] It is explanatory drawing which explains the composition of each ECU which constitutes the control system of an example taking the case of ECU for left bank engines.
[Drawing 3] It is explanatory drawing which expresses with the memory for transmission and the memory for reception of a communications control circuit an example of the data accumulated, respectively.
[Drawing 4] It is a flow chart showing the control processing performed in order to perform various control in each ECU.
[Drawing 5] It is a flow chart showing the state signal setting processing performed in each ECU.
[Drawing 6] It is explanatory drawing showing the signal path at the time of performing failure analysis at the time of a speedometer display heterology.
[Drawing 7] It is a flow chart showing the failure analysis procedure at the time of a speedometer display heterology.
[Description of Notations]
1 -- Engine 3 -- Transmission 5 Seven -- Throttle valve
9 -- Driving wheel 32 -- Display panel 32a -- Speedometer
12 -- Sensor group 14 -- Switch group 16 -- Actuator group
10 -- ECU for left bank engines 20 -- ECU for right bank engines
30 -- ECU for meter 40 -- ECU for ABS-tanned red blood cell
50 -- Communication line 52 -- Signal line 60 -- CPU 60a -- Memory
70 -- Communications control circuit 70a -- Memory for transmission 70b -- Memory for reception

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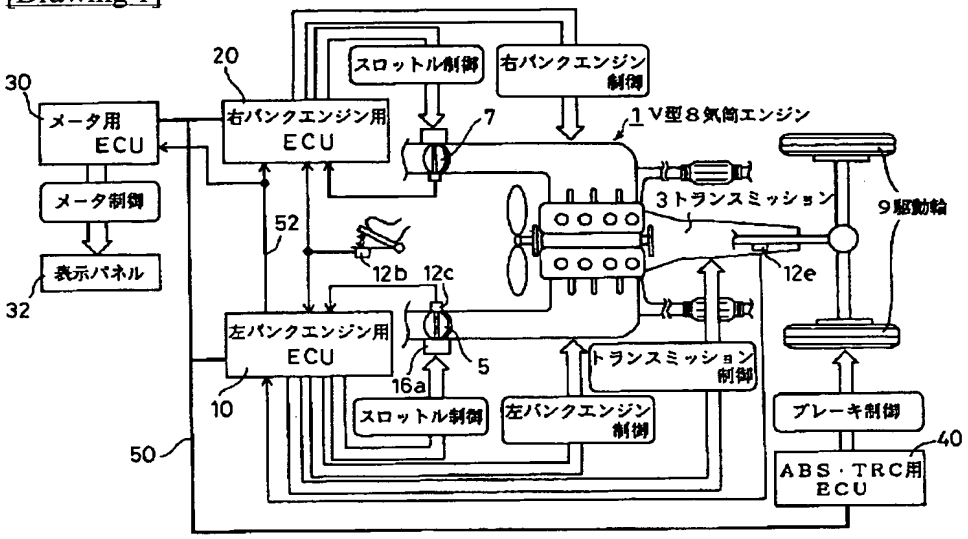
[Translation done.]

* NOTICES *

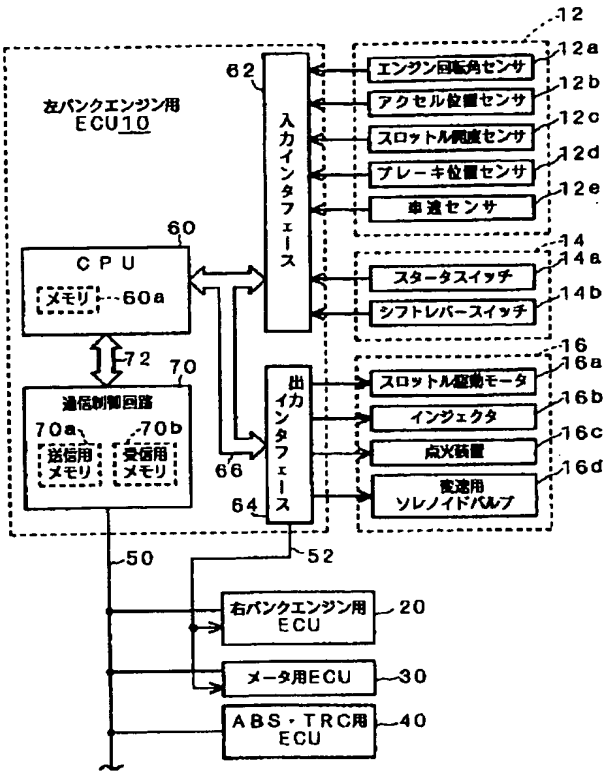
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

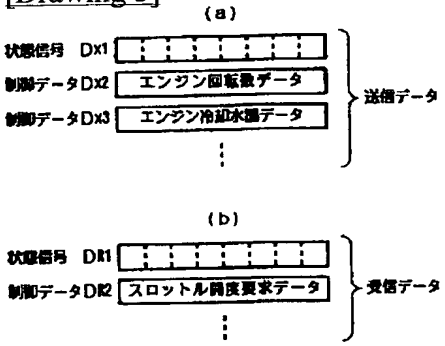
[Drawing 1]



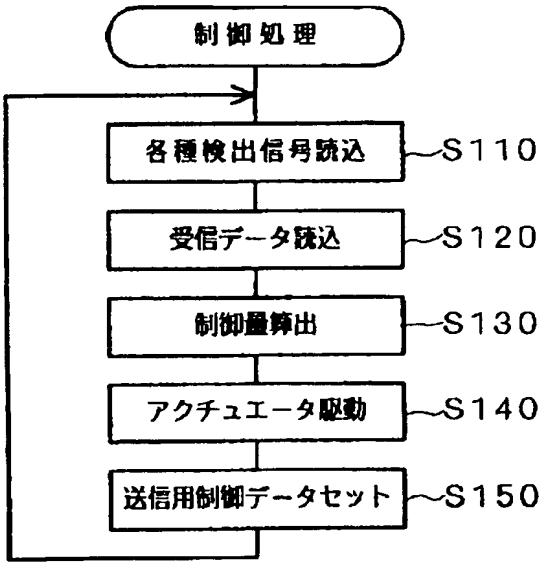
[Drawing 2]



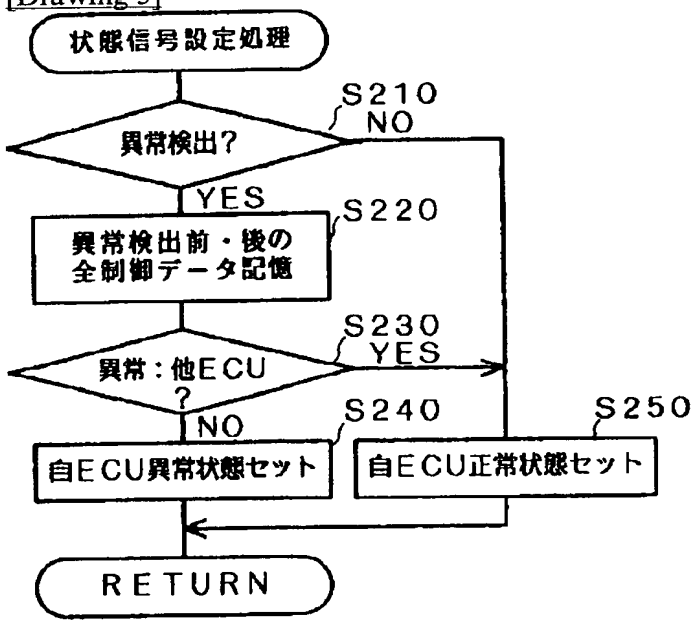
[Drawing 3]



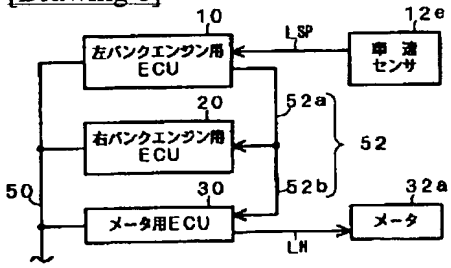
[Drawing 4]



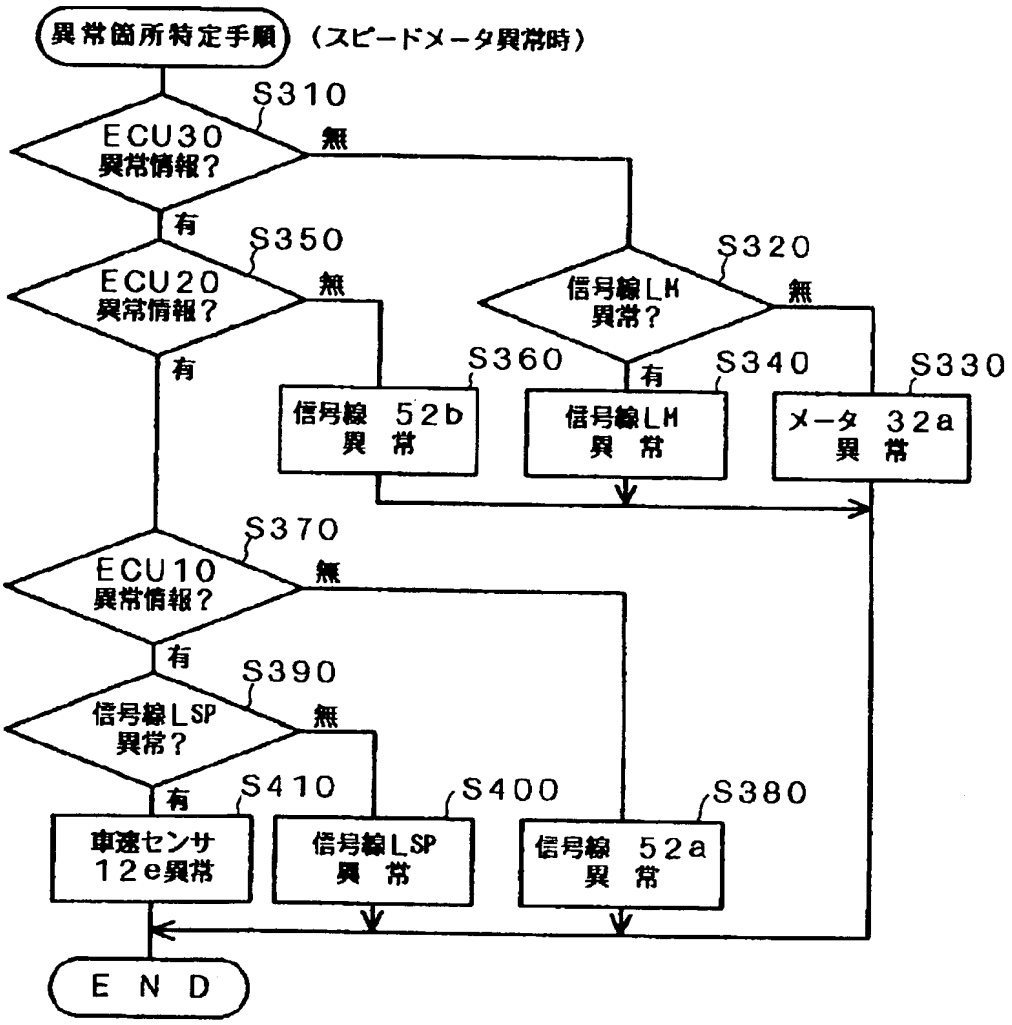
[Drawing 5]



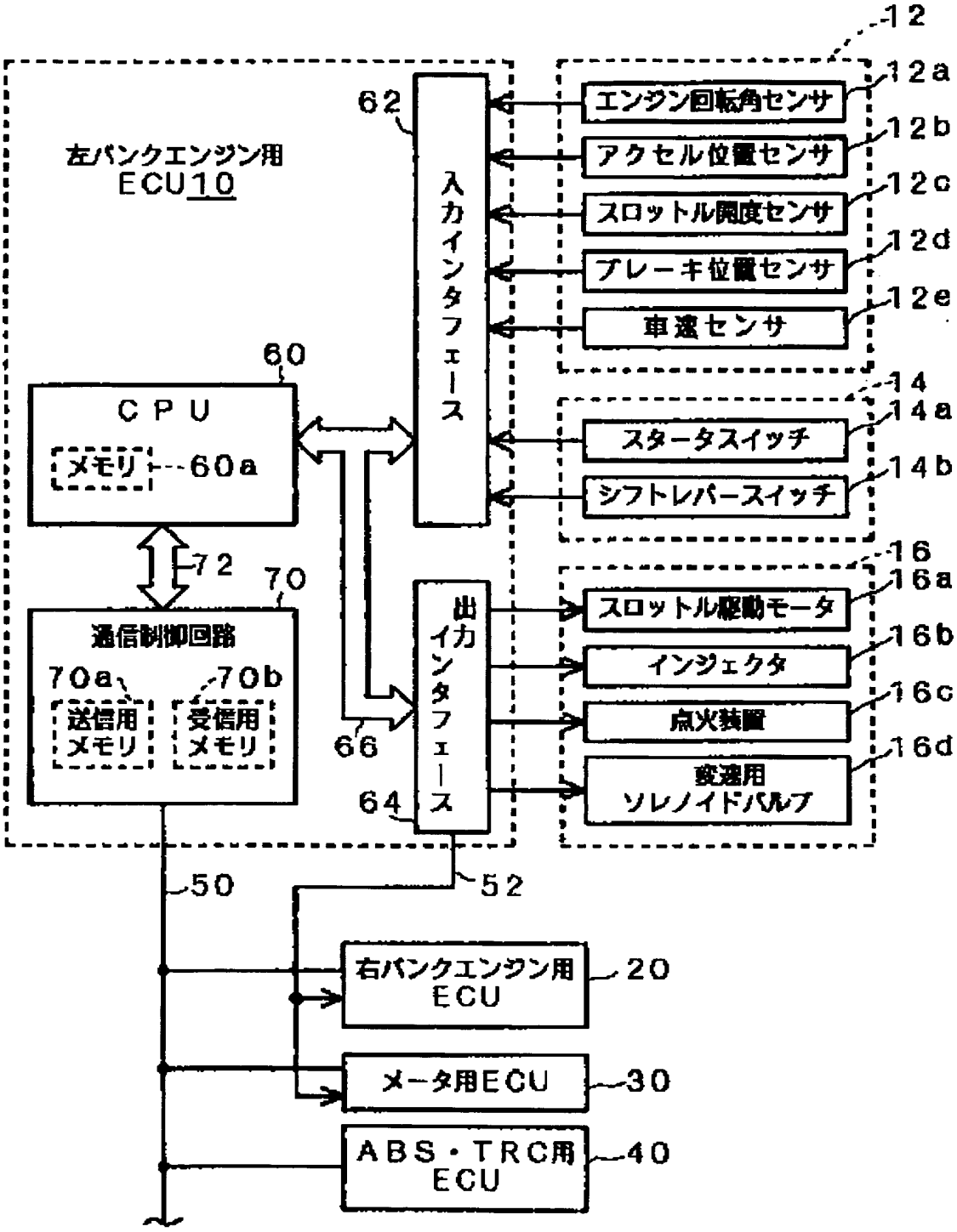
[Drawing 6]



[Drawing 7]



[Translation done.]


12
12a
エンジン回転角センサ
12b
アクセル位置センサ
12c
スロットル開度センサ
12d
ブレーキ位置センサ
12e
車速センサ
62
入力インタフェース
左バンクエンジン用
ECU10
60
CPU
メモリ
60a
72
70
通信制御回路
70a
送信用
メモリ
70b
受信用
メモリ
66
出力インタフェース
64
14
14a
スタータスイッチ
14b
シフトレバースイッチ
16
16a
スロットル駆動モータ
16b
インジェクタ
16c
点火装置
16d
変速用
ソレノイドバルブ
50
52
右バンクエンジン用
ECU
20
メータ用ECU
30
ABS・TRC用
ECU
40

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	12/26		9466－5K	Ｈ０４Ｌ	11/08	
// Ｆ０２Ｄ	45/00	３８０				

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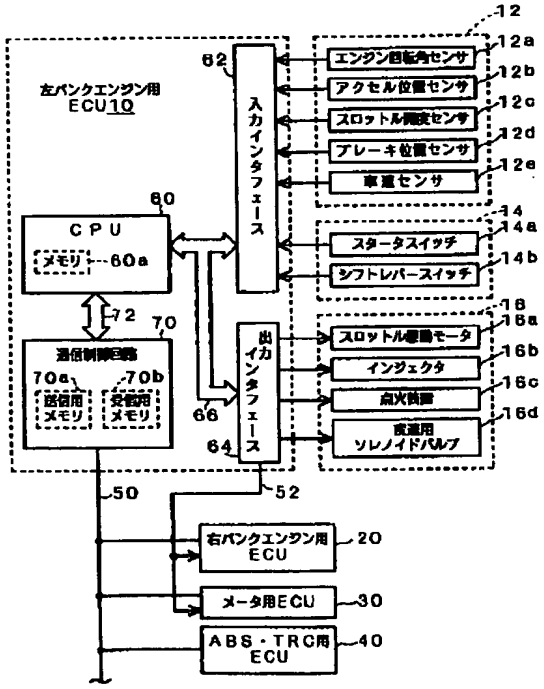
(54)【発明の名称】　電子制御装置

(57)【要約】

【課題】　通信線を介して複数の制御装置を接続した電子制御装置において、何等かの異常が発生した時に故障原因を容易に且つ詳細に特定できるようにする。

【解決手段】　車両各部を制御する複数のＥＣＵ１０～４０を通信回線５０で接続し、各ＥＣＵ内の通信制御回路７０を用いて制御データの一部を送受信する車両用制御システムにおいて、各ＥＣＵにて、センサ群１２又はスイッチ群１４からの検出信号に基づき求めた検出データやアクチュエータ群１６の制御量を演算した演算データ等の異常を検出すると、異常状態信号を他のＥＣＵに送信し、しかも、各ＥＣＵは自ＥＣＵの異常を検出するか、異常状態信号を受信すると、その前後の全制御データをメモリ６０ａに格納する。この結果、当該制御系に異常が発生した場合には、各ＥＣＵにて同時に制御データが記憶されることになり、その制御データから車両状態を詳細に把握して、故障原因を正確に特定できる。



【特許請求の範囲】
【請求項１】　通信手段を有する複数の制御装置を通信線を介して接続し、各制御装置が、制御対象の制御に必要な制御データの一部を、前記通信手段及び通信線を介して他の制御装置との間で送受信することにより、該制御データを他の制御装置と共用する電子制御装置において、
前記各制御装置に、
制御データの異常を検出する異常検出手段と、
該異常検出手段が制御データの異常を検出すると、その旨を表す異常状態信号を、前記通信手段から他の制御装置に送信させる異常状態送信手段と、
前記異常検出手段が制御データの異常を検出したとき、及び、前記通信手段が他の制御装置から送信されてきた異常状態信号を受信したとき、制御対象の制御に使用している制御データを、データを継続的に保持可能な所定の記憶媒体に格納する異常時データ記憶手段と、
を備えたことを特徴とする電子制御装置。
【請求項２】　前記異常時データ記憶手段は、前記異常検出手段が制御データの異常を検出すると、該異常検出前・後の制御データを前記記憶媒体に格納し、前記通信手段が他の制御装置から送信されてきた異常状態信号を受信すると、該異常状態信号の受信前・後の制御データを前記記憶媒体に格納することを特徴とする請求項１に記載の電子制御装置。
【請求項３】　前記複数の制御装置は、車両に搭載されたエンジン，変速機，ブレーキ装置等の各部を夫々分散して制御することを特徴とする請求項１又は請求項２に記載の電子制御装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、複数の制御装置間で、通信線を介して、制御対象の制御に必要な制御データの一部を送受信することにより、各制御装置間で該制御データを共用するように構成された電子制御装置に関する。
【０００２】
【従来の技術】従来より、例えば、車両用のエンジン制御装置では、車両の運転状態を検出するセンサからの検出信号に基づき算出した検出データや、その検出データに従い燃料噴射量や点火時期等の制御量を演算した演算データ等に異常が生じた際には、これら全制御データを、電源遮断等によって記憶データが消失することのない所定の記憶媒体に記憶するようにしたものが知られている。
【０００３】これは、エンジン制御装置を、例えば、エミッション関連部品が故障した際のエンジン制御状態を記憶（フリーズ・フレーム）することを規定した加州オン・ボード・ダイアグ（ＯＢＤ）規制等に適合させ、エンジン制御系に異常が発生した際に、上記記憶した制御データから異常発生時の車両状態を把握して、故障原因を容易に特定できるようにするためである。
【０００４】
【発明が解決しようとする課題】しかし、エンジン制御装置単独で異常検出時の制御データを記憶する従来方式では、記憶する制御データがエンジン制御系のデータに限られるため、その記憶データから、異常検出時の車両状態全体を把握することは困難であり、故障原因を詳細且つ高精度に特定することはできなかった。例えば、車両加速時，車両制動時といった車両の特定の走行条件下でのみ制御データに異常が発生するような場合、その故障原因を特定するには、異常検出時の車両の走行状態を正確に把握する必要があるが、エンジン制御装置単独で異常検出時の制御データを記憶しても、その記憶データから故障原因を特定することはできない。
【０００５】また特に、近年、車両用の制御システムでは、例えばエンジン制御，トランスミッション制御，ブレーキ制御といった個々の制御対象に対する制御を、専用の制御装置が各々独立して行なう、所謂独立型の制御システムから、これら各制御装置を通信線で接続して、各制御装置間で制御データを送受信することにより、各制御装置が制御データを共用して車両を総合的に制御する、所謂統合型の制御システムへと移行しつつあるが、このような統合型の制御システムでは、従来のように、エンジン制御装置等、各制御装置単独で異常検出時の制御データを記憶するようにしても、その記憶データから異常検出時の車両状態を把握して、故障原因を特定することはますます困難になるという問題がある。
【０００６】一方、従来より、例えば特開平３－１８４１５４号公報に開示されているように、複数のコンピュータ間にてデータ通信を行なう通信システムにおいて、あるコンピュータがデータ通信の結果から他のコンピュータの異常を検出すると、残りのコンピュータに対してその旨を報知して、その後異常が発生したコンピュータに対するデータ通信を禁止することにより、各コンピュータ間でのデータ通信を効率よく行なえるようにした通信システムが知られている。そして、こうした技術を上記統合型の制御システムに適用すれば、該制御システムを構成する特定の制御装置の異常を他の制御装置のいずれかが検出したときに、正常動作している全制御装置にその旨を報知して記憶させることができる。従って、この場合、ある制御装置において制御データに何等かの異常が発生した場合に、その原因が他の制御装置の故障によるものであるか否かを容易に判断できるようになる。
【０００７】しかし、統合型の制御システムをこのように構成しても、故障原因が他の制御装置の故障によるものであった場合に、他の制御装置の故障は、通信系の故障によるものであるのか、制御装置自体の異常であるのかといった、詳細な故障原因を特定することは不可能であり、また各制御装置間でのデータ通信自体は問題なく

行なうことができているにもかかわらず、ある制御装置において制御データの異常を検出したような場合には、従来装置と同様、その故障原因を詳細に特定することはできない、といった問題が残る。

【0008】つまり、例えば、ある制御装置①に接続されたセンサからの検出データを他の制御装置②において使用する際に、その検出データの異常を制御装置②において検出した際に、その故障原因が、制御装置①と制御装置②との間の通信系にあるのか、制御装置①自体の故障によるのか、或は制御装置①に接続されたセンサの故障によるのか、といった故障原因の詳細な特定は困難である。

【0009】本発明はこうした問題に鑑みなされたもので、上記統合型の車両制御システムのように、複数の制御装置を通信線を介して接続し、各制御装置間にて制御データを共用可能にした電子制御装置において、ある制御装置にて制御データの異常が検出されたときに、その故障原因を容易に且つ詳細に特定できるようにすることを目的とする。

【0010】

【課題を解決するための手段】かかる目的を達成するためになされた請求項1に記載の電子制御装置では、通信手段を有する複数の制御装置が通信線を介して接続され、各制御装置が、制御対象の制御に必要な制御データの一部を、通信手段及び通信線を介して他の制御装置との間で送受信することにより、その制御データを他の制御装置と共用する。そして、各制御装置には、制御対象の制御に用いる制御データの異常を検出する異常検出手段が備えられ、この異常検出手段が制御データの異常を検出すると、異常状態送信手段が、その旨を表す異常状態信号を通信手段から他の制御装置に送信させる。また、異常検出手段が制御データの異常を検出するか、通信手段が他の制御装置から送信されてきた異常状態信号を受信すると、異常時データ記憶手段が、そのとき制御対象の制御に使用している制御データを、データを継続的に保持可能な所定の記憶媒体に格納する。

【0011】このため、当該電子制御装置を構成する複数の制御装置のうちの一つで何等かの異常が発生して、異常検出手段により制御データの異常が検出されると、各制御装置において、そのときの制御対象の制御状態を表わす制御データが記憶されることになる。

【0012】従って、本発明によれば、各制御装置が制御する複数の制御対象からなる制御系で何等かの異常が発生した場合には、各制御装置の記憶媒体に記憶された制御データから、その異常発生時の制御系全体の動作状態を把握することができ、故障発生原因を容易に且つ詳細に特定することができるようになる。

【0013】ここで、異常時データ記憶手段は、異常検出手段にて制御データの異常が検出されるか、通信手段が他の制御装置から送信されてきた異常状態信号を受信すると、制御対象の制御に使用している制御データを記憶するが、この記憶する制御データとしては、請求項2に記載のように、異常検出手段が異常を検出する前・後又は通信手段が異常状態信号を受信する前・後の制御データを、記憶媒体に記憶することが望ましい。

【0014】つまり、このようにすれば、複数の制御装置のいずれかの異常検出手段にて制御データの異常が検出された前・後の制御系全体の動作状態を把握することができ、異常検出前と異常検出後の制御系各部の動作状態の変化から、故障発生原因をより簡単且つ高精度に特定できるようになる。

【0015】また、本発明の電子制御装置は、請求項3に記載のように、複数の制御装置が、車両に搭載されたエンジン，変速機，ブレーキ装置等の各部を夫々分散して制御することにより、車両の統合制御を実現する所謂統合型の車両制御システムに適用するとより効果的である。

【0016】つまり、車両制御を行なう制御システムでは、制御装置や、これに接続されるセンサ類，アクチュエータ類等の外部機器が、温度・湿度・振動といった外部環境の影響を大きく受ける過酷な条件下で使用されるため、故障が発生しやすく、しかもその故障原因も多岐にわたり、特定の運転条件下でのみ故障が発生することも多いが、本発明によれば、こうした様々な故障原因を、車両を統合制御する各制御装置の動作状態から総合的に判断できるようになるため、従来、故障原因の特定が困難であった異常に対しても故障原因を特定することができるようになる。そして、例えば、従来、ある異常発生時に故障原因と考えられる多数の部品を取り替えていたものを、故障原因をより詳細に特定することにより、交換部品を少なくできるといった効果も得られる。

【0017】

【発明の実施の形態】以下に本発明の実施例を図面と共に説明する。図1は、本発明が適用された実施例の車両用制御システム全体の構成を表わす概略構成図である。

【0018】図1に示す如く、本実施例の車両用制御システムは、V型8気筒エンジン（以下、単にエンジンという）1を搭載した自動車に設けられ、自動車各部を統合制御するための複数の制御装置から構成されている。即ち、本実施例の車両用制御システムは、エンジン1の左4気筒分（左バンク）の吸気系に設けられたスロットルバルブ5を開閉して吸気量を制御するスロットル制御，左バンクの燃料噴射量，点火時期等を制御する左バンクエンジン制御，及びエンジン1から左右駆動輪9に動力を伝達するトランスミッション3の変速段等を制御するトランスミッション制御を行なう左バンクエンジン用の電子制御装置（左バンクエンジン用ＥＣＵ）10と、エンジン1の右4気筒分（右バンク）の吸気系に設けられたスロットルバルブ7を開閉して吸気量を制御するスロットル制御，及び右バンクの燃料噴射量，点火時

期等を制御する右バンクエンジン制御を行なう右バンクエンジン用の電子制御装置（右バンクエンジン用ＥＣＵ）２０と、トランスミッション3から駆動輪９側に至る動力伝達系に設けられた車速センサ１２ｅからの検出信号等に基づき、車速等の車両の走行状態を表わす各種検出データを運転席に設けられた各種メータからなる表示パネル３２に表示するメータ制御を行なうメータ用の電子制御装置（メータ用ＥＣＵ）３０と、車両加速時や制動時に駆動輪９或は駆動輪９を含む全車輪のスリップ状態を検出して、各車輪に設けられたブレーキ装置を制御するブレーキ制御を実行すると共に、必要に応じて各エンジン用ＥＣＵ１０，２０に対してエンジントルクの抑制指令を行なう、トラクション制御（ＴＲＣ）・アンチスキッド制御（ＡＢＳ）用の電子制御装置（ＡＢＳ・ＴＲＣ用ＥＣＵ）４０と、これら各ＥＣＵ１０～４０を互いに接続するデータ通信用の通信回線５０とから構成されている。

【００１９】次に、上記各ＥＣＵ１０～４０の構成を、左バンクエンジン用ＥＣＵ１０を例にとり詳しく説明する。図2に示すように、左バンクエンジン用ＥＣＵ１０は、制御処理手段として、ＣＰＵ，ＲＯＭ，ＲＡＭ等からなるワンチップマイクロコンピュータ（以下、単にＣＰＵという）６０を備えると共に、バス６６を介してＣＰＵ６０に接続された入力インタフェース６２及び出力インタフェース６４を備えている。なお、ＣＰＵ６０は制御プログラムを記憶したり演算データを一時的に記憶したりするメモリの一つとして、電源遮断後もデータを保持可能なメモリ（例えばバックアップＲＡＭ等の記憶媒体）６０ａを備えている。

【００２０】また、入力インタフェース６２には、例えば、エンジンの回転角位置を検出するエンジン回転角センサ１２ａ、アクセルペダルの踏み込み位置を検出するアクセル位置センサ１２ｂ、スロットルバルブ５の開度を検出するスロットル開度センサ１２ｃ、ブレーキペダルの踏み込み位置を検出するブレーキ位置センサ１２ｄ、車両の速度を検出する車速センサ１２ｅ等からなるセンサ群１２と、例えば、スタータモータによるエンジン始動（クランキング）を検出するスタータスイッチ１４ａ、シフトレバー位置を検出するシフトレバースイッチ１４ｂ等からなるスイッチ群１４とが接続され、入力インタフェース６２は、これらセンサ群１２及びスイッチ群１４からの各種検出信号を取り込み、ＣＰＵ６０に入力する。

【００２１】また、出力インタフェース６４には、例えば、スロットルバルブ５の開度位置を制御するスロットル駆動モータ１６ａ、エンジン1の左バンクに燃料を噴射供給するインジェクタ１６ｂ、左バンクの点火コイルに高電圧を誘起し各気筒の点火プラグに点火火花を発生させる点火装置１６ｃ、トランスミッション3の変速段を制御する変速用ソレノイドバルブ１６ｄ等からなるアクチュエータ群１６が接続され、出力インタフェース６４は、ＣＰＵ６０からの制御信号をアクチュエータ群１６を構成する各部に出力する。

【００２２】そして、ＣＰＵ６０は、入力インタフェース６２を介して入力されたセンサ群１２及びスイッチ群１４からの検出信号に基づいて、車両の運転状態を示す各種検出データ（エンジン回転数やアクセルペタル位置等）を演算すると共に、アクチュエータ群１６を駆動制御するための制御量を表わすデータ（スロットル駆動モータ１６ａの制御量、燃料噴射量、点火磁気、自動変速機のギア段等）を演算して、その演算データに対応した制御信号を、出力インタフェース６４を介してアクチュエータ群１６に出力する。

【００２３】また、左バンクエンジン用ＥＣＵ１０には、他のＥＣＵ２０，３０，４０との間で通信回線５０を介してデータ通信を行なう通信手段として、通信制御回路７０が備えられている。通信制御回路７０は、ＣＰＵ６０から転送された図３（ａ）に示す如き送信データを蓄積する送信用メモリ７０ａと、他のＥＣＵ２０～４０から送信され、受信した図３（ｂ）に示す如き受信データを蓄積する受信用メモリ７０ｂとを有している。

【００２４】そして、左バンクエンジン用ＥＣＵ１０内では、ＣＰＵ６０が、他のＥＣＵ２０～４０に送信すべき各種制御データを送信データとして、データ転送線７２を介して送信用メモリ７０ａに格納すると共に、通信制御回路７０にて受信され、受信用メモリ７０ｂに蓄積された他のＥＣＵ２０～４０からの受信データを、データ転送線７２を介して取り込み、その取り込んだ受信データを制御データの一つとして、制御量の演算等に使用する。また、通信制御回路７０は、予め設定された通信プロトコルに従い、送信用メモリ７０ａに蓄積された送信データを他のＥＣＵ２０～４０に送信すると共に、他のＥＣＵ２０～４０から送信データを受信して、その受信データを受信用メモリ７０ｂに格納する。

【００２５】なお、図３（ａ）に示す如く、ＣＰＵ６０は、他のＥＣＵ２０～４０に送信すべきエンジン回転数データ，エンジン冷却水温データ等の各種制御データＤＸ2，ＤＸ3，…に加えて、上記各種検出信号に基づき算出した検出データや制御量の演算データ等の各種制御データの正常・異常を表す状態信号ＤＸ1を、送信データとして送信用メモリ７０ａに格納するようにされており、この状態信号ＤＸ1も他のＥＣＵ２０～４０に送信される。

【００２６】また、他のＥＣＵ２０～４０は、左バンクエンジン用ＥＣＵ１０と略同様の構成を有しており、各々にＣＰＵ６０や通信制御回路７０等を備え、入力インタフェース６２に接続されたセンサ群１２やスイッチ群１４からの検出信号を取り込み、出力インタフェース６４に接続されたアクチュエータ群１６の制御量を演算して、アクチュエータ群１６を制御すると共に、他のＥＣＵとの間でデータ通信を行なう。また、これら他のＥＣ

Ｕ２０～４０も、左バンクエンジン用ＥＣＵ１０と同様、ＣＰＵ６０の動作によって、制御データの正常・異常を表す状態信号ＤＸ1を送信用メモリ７０ａに格納して通信制御回路７０から左バンクエンジン用ＥＣＵ１０を含む他のＥＣＵに送信するようにされている。

【００２７】従って、各ＥＣＵ１０～４０において、通信制御回路７０の受信用メモリ７０ｂには、例えば、図３（ｂ）に示す如く、他のＥＣＵから送信されてきた各種制御データＤＲ2（図はＡＢＳ・ＴＲＣ用ＥＣＵ４０から左バンクエンジン用ＥＣＵ１０に対してエンジントルク抑制のために送信されてきたスロットル開度要求データを表す），…に加えて、他のＥＣＵ側での制御データの正常・異常を表す状態信号ＤＲ1も、受信データとして格納されることになる。

【００２８】そして、各ＥＣＵ１０～４０間のデータ通信において、例えば、左バンクエンジン用ＥＣＵ１０にて制御データの一つとして演算されたエンジン回転数データは、通信制御回路７０及び通信回線５０を介して、メータ用ＥＣＵ３０に送信され、メータ用ＥＣＵ３０では、このエンジン回転数データをタコメータの駆動に用いる。

【００２９】つまり、各ＥＣＵ１０～４０は、制御に必要な制御データの一部を、通信制御回路７０及び通信回線５０を用いたデータ通信により他のＥＣＵから受取り、この制御データを他のＥＣＵとの間で共用するのである。また、本実施例の車両用制御システムでは、左バンクエンジン用ＥＣＵ１０で演算された車速データを、通信回線５０とは別の専用の信号線５２を用いて、右バンクエンジン用ＥＣＵ２０及びメータ用ＥＣＵ３０に順に送信できるようにされている。そして、この車速データは、右バンクエンジン用ＥＣＵ２０において車両の定速走行制御を実行するのに使用されると共に、メータ用ＥＣＵ３０においてスピードメータの表示を行なうのに使用される。

【００３０】なお、これは、通信制御回路７０及び通信回線５０を用いたデータ通信では走行距離の積算演算が困難であるとか、車速データ等の重要な制御データについてはデータ送信系を二重にする必要がある、といったことに鑑みなされたものであり、メータ用ＥＣＵ３０においてスピードメータの表示を行なう際には、信号線５２を介して入力された車速データが使用される。そして、このように車速データ等を専用の信号線５２を介して送信する際には、ＣＰＵ６０自体が通信手段として機能する。

【００３１】次に、上記各ＥＣＵ１０～４０において各種制御を行うために実行される制御処理、及び、その制御処理実行時に制御データの異常を判定して自局（自ＥＣＵ）が正常状態か異常状態を表わす状態信号を他のＥＣＵに送信するための状態信号設定処理について、図４及び図５のフローチャートを用いて説明する。なお、図４及び図５に示すフローチャートは、各ＥＣＵ１０～４０に設けられたＣＰＵ６０が行なう処理の流れを概略的に表わすものであり、より詳細には、制御対象の種類，制御内容等によって各々異なるものである。

【００３２】図４に示す如く、各ＥＣＵ１０～４０において、ＣＰＵ６０は、まずＳ１１０（Ｓ：ステップを表わす）にて、センサ群１２及びスイッチ群１４からの各種検出信号を読み込み、検出データを演算し、続くＳ１２０にて、通信制御回路７０内の受信用メモリ７０ｂから受信データを読み込み、続くＳ１３０にて、Ｓ１１０にて演算した検出データとＳ１２０にて読み込んだ受信データとに基づき、所定制御を実現するための各種制御量を算出し、Ｓ１４０にて、その算出した制御量に応じた制御信号をアクチュエータ群１６に出力して、各種アクチュエータを駆動し、更に続くＳ１５０にて、Ｓ１１０にて求めた検出データやＳ１３０にて求めた制御量を表す演算データの内の、他のＥＣＵに送信すべき送信用制御データを通信制御回路７０内の送信用メモリ７０ａに格納して、再度Ｓ１１０に移行する、といった手順で、Ｓ１１０～Ｓ１５０の処理を繰り返し実行することにより、制御対象制御のための制御処理を実行する。

【００３３】また、こうした一連の制御処理実行時には、検出信号から演算した検出データや、受信用メモリ７０ｂから読み込んだ受信データ、或いはこれらの制御データから演算した制御量の演算結果（演算データ）等に異常があることがある。そこで、上記Ｓ１１０～Ｓ１３０の実行時には、各制御データの正常・異常を判定してその判定結果を表す状態信号を他のＥＣＵへの送信データの一つとして通信制御回路７０の送信用メモリ７０ａにセットする状態信号設定処理を併せて実行する。

【００３４】この状態信号設定処理は、図５に示す如く、まずＳ２１０にて、上記Ｓ１１０～Ｓ１３０の実行時に得られた検出データ，受信データ，演算データ等の異常を判定する。例えば、Ｓ１１０にてセンサ群１２やスイッチ群１４からの検出信号に基づき検出データを演算する際には、検出信号自体或いは検出信号から求めた制御データが異常値になっているか否かを判定し、Ｓ１２０にて受信データを読み込む際には、受信データ中に他のＥＣＵ側での異常を表す異常状態信号が存在するか或いは受信データ中の制御データが異常値になっているか否か等を判定する。

【００３５】そして、Ｓ２１０にて、何等かの異常を検出すると、続くＳ２２０にて、その異常を検出する以前に制御処理にて使用した正常時の全制御データと、異常を検出した現時点の全制御データとをメモリ６０ａに格納する、前述の異常時データ記憶手段としての処理を実行し、続くＳ２３０に移行する。なお、このＳ２２０では、Ｓ２１０にて同一の異常が連続して検出され、その検出前・後の制御データが既にメモリ６０ａに格納されている場合には、制御データの格納処理を実行すること

なく、Ｓ２３０に移行する。

【００３６】次に、Ｓ２３０では、今回検出した異常は、他のＥＣＵからの受信データ中に含まれる異常状態信号によるものか否かを判断する。そして、今回検出した異常は、他のＥＣＵからの異常状態信号によるものでなければ、当該ＥＣＵ側で異常が発生したものと判断して、Ｓ２４０にて、自ＥＣＵにて異常が発生した旨を他のＥＣＵに報知するために、送信用メモリ７０ａに異常状態信号をセットし、当該処理を終了する。

【００３７】一方、Ｓ２１０にて異常を検出できなかった場合、或いは、Ｓ２２０にて、今回検出した異常は他のＥＣＵからの異常状態信号によるものであり、自ＥＣＵは正常であると判定した場合には、Ｓ２５０に移行して、他のＥＣＵに自ＥＣＵは正常状態である旨を報知するために、送信用メモリ７０ａに正常状態信号をセットし、当該処理を終了する。

【００３８】以上説明したように、本実施例の車両用制御システムにおいては、通信回線５０を介して接続された各ＥＣＵ１０～４０が、制御データの正常・異常を判定し、その判定結果に応じた正常状態信号或いは異常状態信号を、通信制御回路７０内の送信用メモリ７０ａにセットすることにより、他のＥＣＵに対して自ＥＣＵの動作状態を報知するようにされている。そして、各ＥＣＵ１０～４０は、自ＥＣＵの異常を検出するか、他のＥＣＵから送信されてきた異常状態信号から他ＥＣＵの異常を検出すると、その検出前・後に得られた全制御データをＣＰＵ６０のメモリ６０ａ内に格納する。

【００３９】このため、本実施例の車両用制御システムにおいて、何等かの異常が発生した場合には、各ＥＣＵ１０～４０のメモリ６０ａに格納された異常検出前後の制御データから、そのときの車両の運転状態を詳細に把握し、故障原因を容易に且つ詳細に特定することが可能になる。

【００４０】例えば、スピードメータの表示異常が発生した場合には、以下に説明する故障解析手順にて、故障個所を簡単且つ詳細に特定することができる。まず本実施例の制御システムでは、車速センサ１２ｅからの検出信号（車速信号）は、一旦、左バンクエンジン用ＥＣＵ１０に取り込まれて、車速データに変換される。そして、この車速データは、左バンクエンジン用ＥＣＵ１０から通信回線５０及び専用の信号線５２を介して他のＥＣＵ２０～４０に送信され、メータ用ＥＣＵ３０がスピードメータの表示を行なう際には、信号線５２を介して入力された車速データを使用する。

【００４１】従って、スピードメータの表示異常が発生した場合、図６に示す車速データの信号経路上で何等かの異常が発生したものと考えられ、その故障原因としては、車速センサ１２ｅ自体の異常，車速センサ１２ｅから左バンクエンジン用ＥＣＵ１０に至る信号線ＬＳＰの断線，左バンクエンジン用ＥＣＵ１０から右バンクエンジン用ＥＣＵ２０に至る信号線５２ａの断線，右バンクエンジン用ＥＣＵ２０からメータ用ＥＣＵ３０に至る信号線５２ｂの断線，メータ用ＥＣＵ３０からスピードメータ３２ａに至る信号線ＬＭ の断線，スピードメータ３２ａ自体の故障等が考えられる。なお、実際には、ＥＣＵ１０～３０のいずれかが故障した際にもスピードメータの表示異常が発生するが、この場合、スピードメータの表示異常だけでなく、他の異常も同時に発生することから、ここでは説明を簡単にするために、各ＥＣＵの異常については言及しないこととする。

【００４２】そして、車速センサ１２ｅ自体の故障或は信号線ＬＳＰの断線による異常の場合には、全ＥＣＵにおいて正常な車速データが得られないため、各ＥＣＵにて車速データの異常が検出され、信号線５２ａの断線による異常の場合には、右バンクエンジン用ＥＣＵ２０及びメータ用ＥＣＵ３０に正常な車速データが入力されないことから、これら各ＥＣＵ２０，３０にて車速データの異常が検出されて、信号線５２ｂの断線による異常の場合には、メータ用ＥＣＵ３０にのみ正常な車速データが入力されないことから、メータ用ＥＣＵ３０でのみ車速データの異常が検出され、信号線ＬＭ の断線或はスピードメータ３２ａ自体の故障による異常の場合には、全ＥＣＵに正常な車速データが入力されることから、いずれのＥＣＵでも車速データの異常は検出されない。また各ＥＣＵにおいて車速データの異常が検出されると、異常状態信号により全ＥＣＵにその旨が報知され、そのときの全制御データが各ＥＣＵのメモリ６０ａ内に格納される。

【００４３】従って、スピードメータ３２ａの表示異常が発生した場合には、例えば、メータ用ＥＣＵ３０に記憶された異常検出時の制御データを用いることにより、図７に示す手順で故障箇所を特定できる。図７に示す如く、メータ用ＥＣＵ３０内に、自ＥＣＵ３０が車速データの異常を検出したことによって記憶された制御データ（以下第１異常情報という）が存在するか否かを確認する（Ｓ３１０）。そして、メータ用ＥＣＵ３０にこの第１異常情報が記憶されていなければ、スピードメータ３２ａ自体或は信号線ＬＭ の異常であることから、信号線ＬＭ に断線等の異常があるかどうかを確認し（Ｓ３２０）、その確認結果に従い、スピードメータ３２ａ又は信号線ＬＭ の異常を特定する（Ｓ３３０，Ｓ３４０）。

【００４４】一方、メータ用ＥＣＵ３０に第１異常情報が記憶されている場合には、メータ用ＥＣＵ３０内に、右バンクエンジン用ＥＣＵ２０が車速データの異常を検出することによって記憶された制御データ（以下第２異常情報という）が存在するか否かを確認する（Ｓ３５０）。そして、メータ用ＥＣＵ３０に第２異常情報が記憶されていなければ、信号線５２ｂの異常を特定する（Ｓ３６０）。

【００４５】また、メータ用ＥＣＵ３０に第２異常情報

が記憶されている場合には、メータ用ＥＣＵ３０内に、左バンクエンジン用ＥＣＵ１０が車速データの異常を検出することによって記憶された制御データ（以下第３異常情報という）が存在するか否かを確認する（Ｓ３７０）。そして、メータ用ＥＣＵ３０に第３異常情報が記憶されていなければ、信号線５２ａの異常を特定する（Ｓ３８０）。

【００４６】また更に、メータ用ＥＣＵ３０に第３異常情報が記憶されている場合には、信号線ＬＳＰ又は車速センサ１２ｅ自体が異常であることから、信号線ＬＳＰに断線等の異常があるかどうかを確認し（Ｓ３９０）、その確認結果に従い、信号線ＬＳＰ又は車速センサ１２ｅの異常を特定する（Ｓ４００，Ｓ４１０）。

【００４７】このように、本実施例の車両用制御システムによれば、スピードメータの表示異常等、各種制御を実行する上で何等かの異常が発生した場合には、各ＥＣＵ１０～４０のメモリ６０ａにその異常が発生した前後の全制御データが記憶されるため、修理或は点検を行なう際には、各ＥＣＵ１０～４０に記憶された異常検出時の制御データから、車両状態を詳細に把握して、故障原因を容易に且つ詳細に特定することができるようになるのである。

【００４８】なお、上記説明では、故障箇所を特定する際の解析手順として、比較的簡単に行なうことのできるスピードメータの表示異常発生時の解析手順を例にとり説明したが、本発明を用いれば、こうしたスピードメータの表示異常発生時に限らず、どのような異常であっても、各ＥＣＵ１０～４０に記憶された異常検出時の制御データを用いて、故障解析を行ない、故障箇所を特定できる。また、上記説明では、メータ用ＥＣＵ３０に記憶された制御データを用いて、スピードメータ表示異常時の故障解析を行なう場合について説明したが、こうした故障解析は、どのＥＣＵに記憶された制御データを用いても、同様に行なうことができる。従って、仮に通信回線５０に接続されたＥＣＵの内、特定のＥＣＵが故障したとしても、他のＥＣＵに記憶された制御データを用いて故障解析を正確に行なうことができる。

【００４９】そして、本実施例によれば、いずれかのＥＣＵで異常を検出すると、通信回線５０に接続された全てのＥＣＵが、そのとき制御に用いている全制御データを記憶するので、これら全制御データを解析すれば、異常発生時の車両の運転状態を詳細に把握できる。従って、例えば、ＴＲＣ制御が実施された時に異常状態となるという限られた運転状態での故障解析にも有効となることは言うまでもない。

【００５０】また、上記実施例では、各ＥＣＵ１０～４０において、ＣＰＵ６０は、自ＥＣＵ又は他ＥＣＵが異常を検出すると、単に、その異常検出前後の全制御データを記憶するものとして説明したが、異常検出前後の全制御データを複数回にわたり順次記憶するようにすれば、各ＥＣＵ１０～４０において連続的に異常が発生した場合の異常の発生順序を知ることができるようになり、故障原因の特定をより効率よく行うことが可能になる。

【００５１】また更に、上記実施例では、本発明を車両用制御システムに適用した場合について説明したが、本発明は、複数の制御装置を通信線にて接続して、各制御装置が制御データの一部を共用するようにした電子制御装置（システム）であれば、上記実施例と同様に適用して、同様の効果を得ることができる。

【図面の簡単な説明】

【図１】　実施例の車両用制御システムの構成を表わす概略構成図である。

【図２】　実施例の制御システムを構成する各ＥＣＵの構成を左バンクエンジン用ＥＣＵを例にとり説明する説明図である。

【図３】　通信制御回路の送信用メモリ及び受信用メモリに夫々蓄積されるデータの一例を表わす説明図である。

【図４】　各ＥＣＵにおいて各種制御を行うために実行される制御処理を表わすフローチャートである。

【図５】　各ＥＣＵにおいて実行される状態信号設定処理を表わすフローチャートである。

【図６】　スピードメータ表示異常発生時に故障解析を行なう際の信号経路を表わす説明図である。

【図７】　スピードメータ表示異常発生時の故障解析手順を表わすフローチャートである。

【符号の説明】

１…エンジン　　３…トランスミッション　　５，７…スロットルバルブ

９…駆動輪　　３２…表示パネル　　３２ａ…スピードメータ

１２…センサ群　　１４…スイッチ群　　１６…アクチュエータ群

１０…左バンクエンジン用ＥＣＵ　　２０…右バンクエンジン用ＥＣＵ

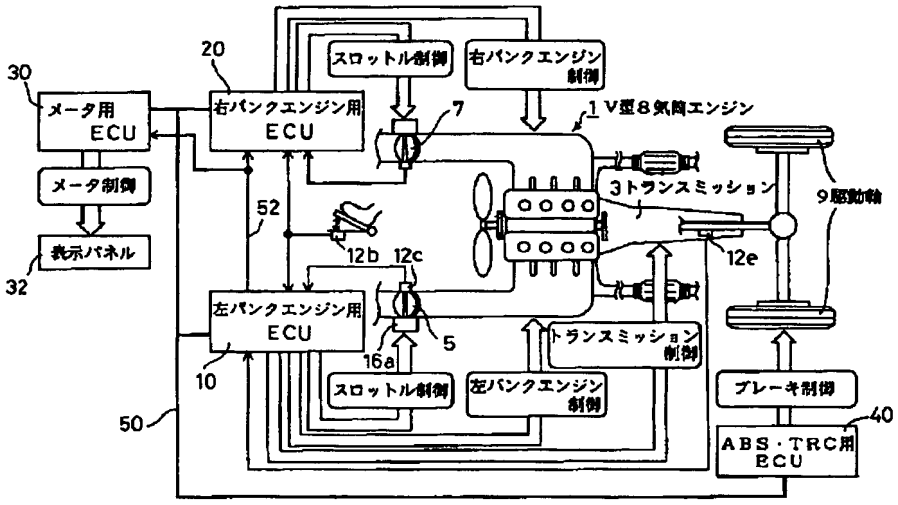
３０…メータ用ＥＣＵ　　４０…ＡＢＳ・ＴＲＣ用ＥＣＵ

５０…通信回線　　５２…信号線　　６０…ＣＰＵ

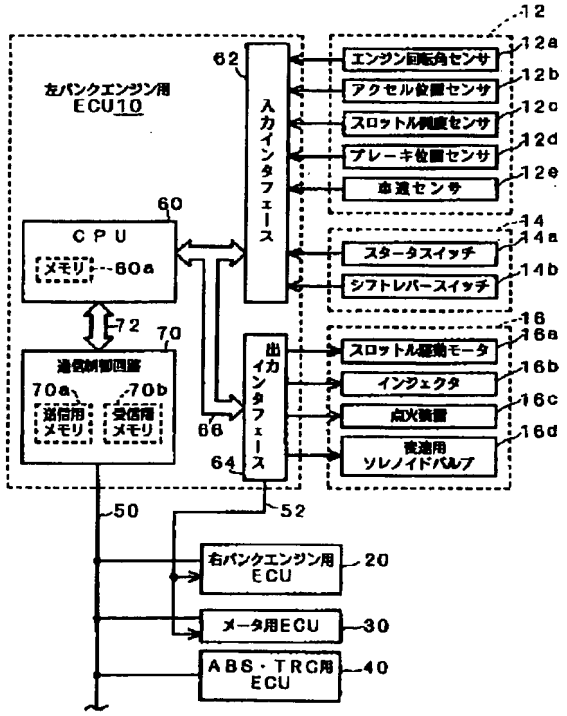
６０ａ…メモリ

７０…通信制御回路　　７０ａ…送信用メモリ　　７０ｂ…受信用メモリ

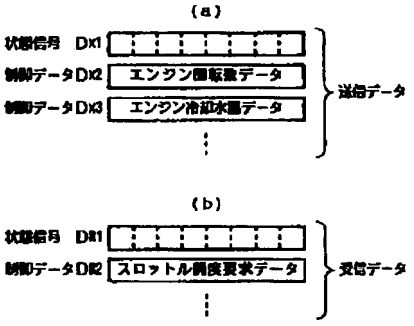
【図1】


メータ用 ECU
メータ制御
表示パネル
右バンクエンジン用 ECU
スロットル制御
右バンクエンジン制御
1V型8気筒エンジン
3トランスミッション
9駆動輪
12e
左バンクエンジン用 ECU
トランスミッション制御
スロットル制御
左バンクエンジン制御
ブレーキ制御
ABS・TRC用 ECU
12b
12c
16a
5
7
52
10
50
40
30
20
32

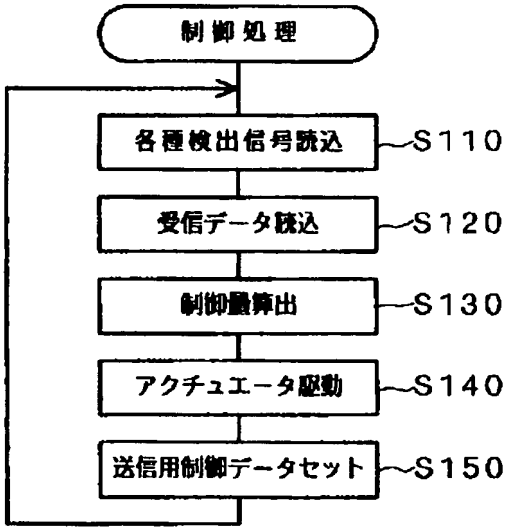
【図2】


左バンクエンジン用 ECU10
CPU
メモリ
60a
60
62
入力インタフェース
出力インタフェース
64
66
72
70
通信制御回路
70a
送信用メモリ
70b
受信用メモリ
12
エンジン回転角センサ
12a
アクセル位置センサ
12b
スロットル開度センサ
12c
ブレーキ位置センサ
12d
車速センサ
12e
14
スタータスイッチ
14a
シフトレバースイッチ
14b
16
スロットル駆動モータ
16a
インジェクタ
16b
点火装置
16c
変速用ソレノイドバルブ
16d
50
52
右バンクエンジン用 ECU
20
メータ用ECU
30
ABS・TRC用 ECU
40

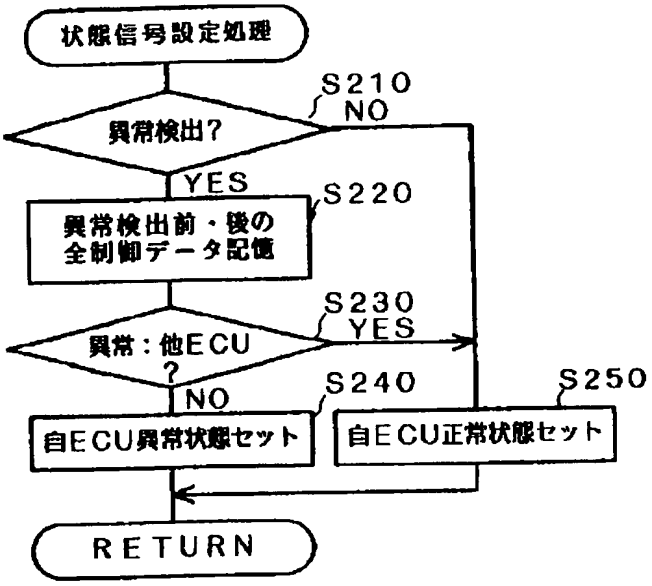
【図3】


(a)
状態信号 Dx1
制御データDx2
エンジン回転数データ
制御データDx3
エンジン冷却水温データ
送信データ
(b)
状態信号 Dr1
制御データDr2
スロットル開度要求データ
受信データ

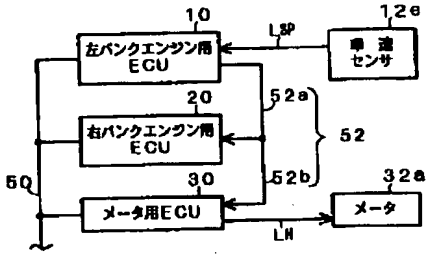
【図4】


制御処理
各種検出信号読込
S110
受信データ読込
S120
制御量算出
S130
アクチュエータ駆動
S140
送信用制御データセット
S150

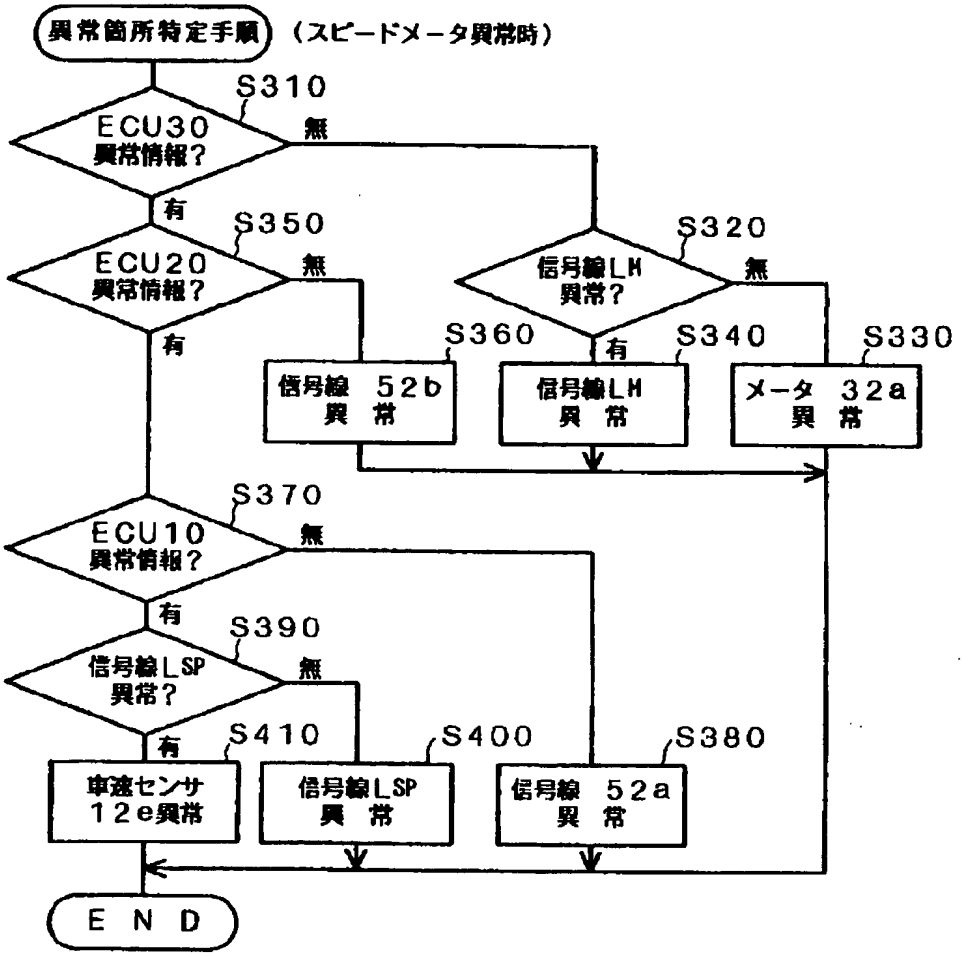
【図5】


状態信号設定処理
S210
異常検出?
NO
YES
S220
異常検出前・後の
全制御データ記憶
S230
異常：他ECU
?
YES
NO
S240
自ECU異常状態セット
S250
自ECU正常状態セット
RETURN

【図6】


10
左バンクエンジン用
ECU
LSP
12e
車速
センサ
20
右バンクエンジン用
ECU
52a
52
50
30
52b
32a
メータ用ECU
メータ
LH

【図7】


異常箇所特定手順
（スピードメータ異常時）
S310
ECU30
異常情報？
無
有
S350
ECU20
異常情報？
無
有
S320
信号線LM
異常？
無
有
S360
信号線　52b
異　常
S340
信号線LM
異　常
S330
メータ　32a
異　常
S370
ECU10
異常情報？
無
有
S390
信号線LSP
異常？
無
有
S410
車速センサ
12e異常
S400
信号線LSP
異　常
S380
信号線　52a
異　常
E N D